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No. 37

NEW EOCENE SPECIES FROM ALABAMA

BY

T. H. ALDRICH

March 6, 1921

* * *

Harris Co.
Cornell Univ., Ithaca, N. Y.
U. S. A.

PREFACE.

The late Herbert H. Smith, curator of the Alabama State Museum of Natural History University, Alabama, made extensive collections in the Tertiary of Alabama, and at the time of his sudden and lamented death was engaged in classifying and arranging his material. The collections were made on joint account for the Carnegie Museum of Pittsburg and the Alabama Museum of Natural History. The condition of the material made it necessary to go over all of it, and classify it for division as well as to describe what was considered new. The writer has also added a few new species from his collecting. It is regretted that Mr. Smith was not spared to complete his labors, because his ability in specific determinations was almost unique. The types of the new species collected by him are all in the University Museum. We are indebted to Dr. W. H. Dall, Dr. Paul Bartsch, Prof. G. D. Harris and Dr. E. A. Smith for generous aid in both specific and generic determinations of doubtful forms.

NEW EOCENE SPECIES FROM ALABAMA

BY

T. H. ALDRICH

Mitramorpha turriculata, n. sp. Pl. I. Fig. I.

Shell small, biconic, whorls eight, three embryonic and smooth, the fourth with strong longitudinal ribs, which continue over the other whorls, dying down some on the body whorl. Spiral striæ numerous, and impressed, a strong double band bordering the suture, aperture narrow, smooth within. Length 6 mm.

Locality.—Choctaw Corner, Ala. Woods Bluff horizon.

Type.—My cabinet.

Remarks.—This little shell seems to be nearest to *Mitramorpha;* it has a glazed appearance ; there is some evidence of a slight notch on and above the periphery of the body whorl.

Turris (Pleurotoma) nodoideus, n. sp. Pl. I. Figs. 2, 3.

Shell small, spire pointed, whorls nine ; first four embryonic, the fifth bearing longitudinal ribs in part, and revolving lines in part with the ribs also present but without the subsutural collar below. The sixth, seventh and eighth whorls with the bordering part of the ninth carrying first, a subsutural collar which becomes doubled and thicker towards the body whorl and is marked with very numerous raised lines belonging to the fasciole; second, just below is a rather broad concave revolving space reaching to the peripheral parts of the whorls carrying very numerous close set semicircular anal markings, these continue over the body whorl in curved raised lines : third, the periphery sometimes carrying a couple of coarse lines followed below by from four to six raised lines, also raised longitudinal ribs from the periphery to suture. Body whorl with raised revolving lines extending to the end of the canal, carrying a few alternating ones below the periphery ; aperture smooth within ; canal slightly rostrate.

Locality.—Cave Branch, 6 miles E. of Thomasville, Ala. Woods Bluff beds.

Type.—Ala. Museum. University, Ala.

Remarks.—This species seems to differ in some respects from any heretofore described, but it may be only a variety of some existing species like *Turris denticula* Bast. *et. al.* The fact is that the Woods Bluff beds at Cave Branch contain so many numerous varieties that it is almost impossible to locate them properly. The whole subject of species in this family needs careful study. The young are often obtuse, and differ in shape and ornamentation from the adult so that they could be called new species, and pass muster while a series would connect them all together. Am not prepared to go into details but hope this subject will be looked into by some of our younger students. Some specimens may be hybrids, and are altogether perplexing. One ought to have authentic specimens of the described species to even begin the examination. All the species of this group from this locality seem somewhat stunted.

Turris specus, n. sp., Pl. I. Figs. 4, 5.

Shell small, whorls probably seven (the embryonic tip is defective) first three embryonic, then four spiral whorls ornamented with a strong subsutural collar, then a slightly concave revolving fasciolar space covering about one fourth of the whorl, followed by a coarse cancellated surface ; the ribs cut by about four impressed revolving lines making a series of nodes, body whorl with the same ornamentation above followed by coarse revolving lines growing finer to the base ; outer lip smooth inside, columella thickened, base somewhat rostrate.

Locality.—Cave Branch, Ala. Woods Bluff beds.

Type.—Ala. Mus. of Nat. History, University, Ala.

Microdrillia rostratula Csy.

This species described by Col. Casey in 1903 bears a certain resemblance to *Pleurotoma insignifica* Heilpr. (*Fusus nanas* Lea) and has been referred to this species, but specimens before me show differences as follows: Col. Casey says the "body whorls are about four in number." My specimens have five, also in the embryo there is sometimes but one costulate whorl, while *Pleuro. insignifica* Heilpr. has but three embryonic whorls, all smooth, and no costulate ones. The two species seem to be quite distinct. The Texas form mentioned by Prof. Harris is probably the same as Heilprin's species.

SPECIES TO BE ADDED TO THE WOODS BLUFF FAUNA—FROM CAVE BRANCH, ALA.

Exilia pergracilis Con.
Cylichna deKayi Lea.
Cancellaria alveata Con.
" *costata* Lea.
Pasithea guttula Lea (H. H. Smith).
Cancellaria panones Harris.
Ancillaria subglobosa Con.
Levifusus suteri Aldr.
Caricella dolita Con.
Drillia lonsdalii Lea.
Barnea alatoidea Aldr.
Diplodonta nana Lea.
Egerella subtrigonia Lea.
Tellina leana Dall.

Turris bimoniatus, n. sp. Pl. I. Fig. 6.

Shell small, whorls probably ten, spire on the type partially missing. Another specimen shows four embryonic smooth whorls. The four spiral whorls and part of the fifth ornamented with curved sinuosities covering the main part of the whorls, a strong collar below the sutures, the balance showing a double collar with a concave space between ; the whole of the surface with numerous spiral raised lines. Aperture about a third of the length of shell, lines on the base have a tendency to alternate. Length 14 mm.

Locality.—Cave Branch, Ala. Woods Bluff beds.

Type.—Ala. Museum, University, Ala.

Remarks.—This seems to combine the characteristics of two or more species, and if there were only one specimen, could be considered a variety. It seems to be related to *T. moniliata* Heilpr.

Pleurotoma (Peratotoma) Gardneri, n. sp. Pl. 1. Figs. 7, 8.

Shell medium, substance rather thin, broadly conic ; whorls nine to ten, embryonic ones four in number, the spire very small, but the whorls rapidly expanding, the permanent whorls profusely ornamented with both longitudinal and spiral raised lines, the peripheral part and below carrying nodes while the spirals are alternate in size and thickness. Body whorl large, shouldered, profusely ornamented, the spirals nodular ; just below the suture there are a couple coarser than the others and also at base ; aperture half the length of the shell, smooth within, inner lip with a thin callus ; canal recurved and slightly spatulate. Length 21 mm.

Locality.—Pugh's branch of Satilpa Creek, Ala., Gosport Sand.

Type.—Ala. Museum of Nat. History, University, Ala.

Remarks.—This species is on the borderland between *Fusus*, *Strepsidura* and *Pleurotoma*. It is very close to *Pl. heilprini, nobis* from Jackson, Miss. The largest specimen is 25 mm. in length. The slit is not pronounced. Named in honor of Miss Julia A. Gardner of the National Museum.

Odostomia (Evalea) Bartschi, n. sp. Pl. 1. Fig. 9.

Shell small, whorls six, spire almost totally immersed, shell rather rapidly expanding. Basal whorl large, suture deep, aperture oblong. One strong, straight fold on the columella placed centrally; umbilicus open, inner lip somewhat recurved at base. Surface not smooth, carrying microscopic incised spiral lines. Length 3 mm.

Locality.—Found at both Gregg's and Bell's Landings.

Type.—From Bell's Ldg. In the Ala. Museum.

Turbonilla (Ptycheulimella) clinensis, n. sp. Pl. 1. Fig. 10.

Shell small, narrow, whorls eight, two embryonic, the next three longitudinally striated, balance smooth. Spire blunt, suture distinct, aperture small. Outer lip smooth within, inner lip with a strong fold curving up into the aperture and bordering the base. Length 3+ mm.

Locality.—Gregg's Landing, Ala.

Type.—Alabama Museum, University, Ala.

Remarks.—Seems to be a distinct species. There are three other species of *Turbonilla* in the State Collection but too imperfect to warrant description.

Turbonilla (Cingulina) tuscahomensis, n. sp. Pl. 1. Fig. 11.

Shell small, whorls nine, the first three embryonic ; apex small, the fourth and fifth whorls with raised spirals, balance carrying five strong spirals, and somewhat cancellated ; suture deeply impressed. The space above the first or lowest spiral slightly wider than between the other four. Aperture broadly ovate ; inner lip slightly reflected ; base slightly spatulate. Length 4 mm. Figured specimen from Bell's Ldg.

Locality.—Both Gregg's and Bell's Ldg., Alabama.

Type.—Alabama Museum of Nat. History.

Remarks.—Looks like a *Bittium*.

Turbonilla (Ptycheulimella) tardiusculus, n. sp. Pl. 1. Fig. 12.

Shell with nine whorls, the first two embryonic, the balance smooth and of a dull brown color, substance of shell rather solid, suture lightly impressed, banded below. Aperture small, inner lip reflected at base, imperforate ; no fold showing on the columella. Two specimens found. Length 4½ mm.

Locality.—Cave Branch, Ala. Woods bluff beds.

Type.—My collection.

Pyramidella (Iphiana) anita Ald.

The Nautilus, Vol. XXI, No. 1, p. 9, Pl. 1, Fig. 12, May, 1907.

This species was described as a *Turbonilla*, but is now put into the *Pyramidellidæ* by Dr. Bartsch.

Pyramidella (Syrnola) mitchelliana Aldr.

Bull. of American Paleontology, No. 22, P. 8, Pl. 3, Fig. 3, 1911.

Is also removed from *Turbonilla.*

The Ala. Museum has a number of new forms of small species, collected by Mr. Herbert A. Smith which are described herein. They have been submitted to Dr. Bartsch who has kindly indicated their generic position.

Pyramidella (Iphiana) obtusoides, n. sp. Pl. 1. Fig. 13.

Shell small, with four whorls capped by two embryonic ones turned abruptly to the back side of shell and partially immersed. The specimens, three in number, have a dull surface, apparently smooth, but under a glass numerous spiral lines are seen. Suture not deeply impressed ; aperture oblong-ovate ; outer lip sharp, smooth within ; inner lip reflected, somewhat twisted, carrying a single small tooth. Length 3½ mm.

Locality.—Found at both Gregg's and Bell's Landings, Ala. River, Ala.

Type.—Ala. Museum of Natural History.

Remarks.—A short, dull-looking species.

Epitonium munistriatum, n. sp. Pl. 1. Figs. 14, 15.

Shell small, aciculate whorls, probably 10 or more. Embryonic ones three in number, apex pointed ; the next two or three with longitudinals only, balance cancellated. Whorls rounded, suture deep. Spirals 5 to 7, rather coarse, ribs raised with concave spaces between, base with smaller alternate spirals between the primaries ; intersections pointed. The base of this species (15) is in the Museum from Gregg's Landing, Ala. The other specimen is from Woods Bluff, Ala. The aperture shows a a thickened inner lip where it joins the base, also a thin callus.

Locality.—As above.

Type—Ala. Museum of Nat. History.

Epitonium multiliniferum, n. sp. Pl. 1. Fig. 16.

All the specimens are fragmentary, but well marked. Embryonic whorls missing ; suture distinct. Ribs on body whorl 34 in number, extending over the base, much weaker there ; very numerous close set spiral lines between the ribs. Aperture round, inner lip thickened, no umbilicus.

Locality.—Cave Branch, Ala. Woods Bluff beds.

Type.—My cabinet.

Remarks.—This is a distinct species and it deserves differentiation from the other forms. The figure given by Prof. Harris in Bull. Am. Paleontology, No. 11, Pl. 12, Fig. 8, is probably a young example of this species. The sides are more nearly parallel than in most *Epitoniums*.

Epitonium subacutum, n. sp. Pl. 1. Figs. 17, 18.

Shell thin, narrowly acute, whorls 12. The first five are embryonic and smooth ; the balance spirally striated ; cancellated. The vertical ribs on the body whorl about twenty-six in number, curving into the umbilicus. They are thin or acute ; the primary spirals about ten in number with finer alternate lines between ; inner lip with a slight callus. Length 10 mm.

Locality.—Cave Branch, Ala. Woods Bluff beds.

Type.—In Ala. Museum. One specimen shows the base and the other the embryonic shell.

Teinostoma subangulata Mr. var. **Smithii**, n. var. Pl. 1. Figs. 19, 20.

Shell small, flattened above, rounded below ; umbilicus not large ; a callus on the base which enters the umbilicus and continues within. Bordering the suture is an appressed area raised above the whorls ; surface above with numerous close set revolving lines ; periphery smooth with a few revolving lines below. Aperture circular ; outer lip somewhat thickened ; lines of growth perceptible ; interior somewhat pearly. Diameter 8 mm.

Locality.—Bell's Landing, Ala.

Type.—Ala. Museum of Natural History.

Remarks.—Very much larger than the type of *T. subangulata* Mr. Looks very much like a land shell. It differs somewhat from Meyer's species in the shape of the aperture.

Teinostoma regularis, n. sp. Pl. 1. Figs. 21-2.

Shell small but larger than the ordinary species of this genus ; whorls five, depressed above ; periphery rounded ; surface covered with fine lines which are crossed with lines of growth. Under a glass the intersections give the surface a beaded appearance ; a depressed space just below the suture. The base has coarser lines with a smooth space around the umbilicus which is open ; aperture oval. Diameter 4 mm.

Locality.—Pugh's Branch of Satilpa Creek, Clark Co., Ala. Gosport Sand.

Type.—Ala. Museum at University, Ala.

Remarks.—This little shell may possibly belong to the subgenus *Omphalius* of *Chlorostoma* but it seems closer to *Teinostoma*.

Ancillopsis Tuomoyi, n. sp. Pl. 1. Figs. 23, 24.

Shell solid, thick, oblong, smooth and shining ; whorls 5-6 ; spire rather pointed ; the first four whorls small, the others rapidly increasing ; a swollen callus reaching above the body whorl and also covering the front of this whorl and lapping over the back of this whorl. A deep suture reaches the aperture where it is rather wide ; a few irregular lines of growth are visible ; aperture about three-fourths the length of the shell, oblong-ovate; columella smooth, concave. The basal groove shows strongly at base, but only showing a short distance up where it is covered by the enamel. Length 28 mm ; breadth 21 mm.

Locality.—Bell's Landing, lower bed, also one example from Gregg's Landing, Ala. The lower bed at Bell's Landing is the same bed as at Gregg's Ldg. Type from Bell's Landing, lower bed.

Type.—Ala. Museum of Nat. History.

Remarks.—This species resembles *Macron* in some respects but is evidently an *Ancillopsis*.

Nassa pleona, n. sp. Pl. 1. Figs. 25, 26.

Shell small, nuclear whorls broken off. Four remaining whorls carry longitudinal ribs that are crossed by two spirals, nodular at intersections. Two close set spirals border the suture above and below same ; suture channelled ; the last whorl carries about 10 widely spaced spirals, raised and nodular with concave spaces between. Outer lip thickened with the spirals extending over same, denticulated ; inner lip enameled with the spirals showing through the same. Canal very short ending in a semicircular opening. Length 12+ mm. Two specimens obtained.

Locality.—Lisbon, Ala.

Type.—My cabinet.

Olivella semilignitica, n. sp. Pl. 1. Figs. 27, 28.

Shell small, whorls six, four smooth ; the fourth and subsequent ones bounded by a raised band just below the suture ; apex blunt, body whorl showing impressed lines of growth ; aperture as in the genus. Length 5½ mm.

Locality.—Clark County, Ala. Woods Bluff horizon.

Type.—Ala. Museum of Nat. History.

Remarks.—The sutural callosity pronounced on the last whorl only. Differs from *O. mediavia* Harris in being smaller, more blunt, with fewer folds on the columella, and by a raised sutural band.

Gilbertia estellensis, n. sp. Pl. 2. Figs. 6, 7.

Shell globular, whorls three ; the first embryonic ; the second spirally striated but very narrow ; the third very globose and spirally striated ; outer lip thickened and broadly reflected ; a single tooth projecting into the aperture from it ; inner lip thickened with a broad spatulate tooth above, and two prominent teeth near the base ; the outer lip partially covering the second whorl. Under a glass the striæ show that they are pitted as in *Actæon.* Height 2½ mm. ; breadth 2 mm.

Locality.—Sucarnoochee beds, 3 miles south of Estella, Ala.

Type.—Ala. State Museum, University, Ala.

Cancellaria Gilberti, n. sp. Pl. 1. Fig. 29.

Shell with seven whorls remaining ; the spire is damaged ; cancellated ; suture deeply impressed and constricted, especially on the lower whorls. Below the suture is a raised cord marked with a spiral line upon the lower whorls ; above the suture is a wider space bounded by strong raised spirals with other raised spirals above. Body whorl expanded with a strong spiral at the periphery ; those above this are close together, those below alternated with a finer spiral ; lines of growth show on body whorl reversing near the base ; aperture oblong-ovate, the spiral lines rounding into same ; columella with two folds ; shell has a small umbilicus. Labrum lirate within. Length 9 mm.; breadth 4 mm.

Locality.—Gregg's Ldg., Ala. River, Ala.

Type.—Ala. Museum of Nat. History.

Remarks.—Only one specimen found. This species has many of the characters of *Admete.*

Ovula regularoidea, n. sp. Pl. 1. Fig. 30.

Shell small, elongate ; both anterior and posterior with fine revolving lines ; main body of shell smooth ; outer lip thickened and crenulated from beak to base ; inner lip also crenulated its whole length ; a heavy callus on the outer surface of the columella at the posterior end with the canal extending beyond the callus. On the smaller of the two specimens before me there are fine revolving lines half way down from the posterior ; aperture narrow, expanding back of the anterior canal ; ends somewhat flattened. Length of largest specimen 14 mm.

Locality.—Bell's Landing marl, Ala. River, Ala.

Type.—Ala. Museum of Nat. History.

Cypræa estellensis, n. sp. Pl. 2. Fig. 1.

Shell small ; rotund ; smooth ; aperture narrow ; outer lip curving into the apex which is open. Length 12 mm. Breadth 10 mm.

Locality.—Sucarnoochee beds, Pursley Creek, Wilcox Co., Ala.

Type.—Ala. State Museum.

Remarks.—This specimen has only preserved the shell in part but the interior is hard rock and gives the form quite accurately. The aperture is all filled with matrix, hiding the dentition. Prof. Harris mentions finding one species at Fort Gaines on the Chattahoochee and another (which is probably the one subsequently described ½ mile north of Ripley, Miss.) They are figured and named as they seem to be rare and peculiar to this horizon.

Cypræa sp.? Pl. 2. Figs. 2, 3.

Shell small; surface smooth; basal callus extending partially over the sides; outer lip expanded; extremities somewhat pointed. One fragment shows the dentition, consisting of over 20 small teeth on the inner lip. Length of the larger fragment 15 mm.

Locality.—Sucarnoochee beds, one and three miles south of Estella, Ala. on Pursley Creek.

Types.—Ala. Museum of Nat. History.

Seems to be rather close to *Cypræa Smithi nobis* from Gregg's Ldg., Ala.

Siphonalia quadrilineata, n. sp. Pl. 2. Figs. 4, 5.

Shell resembling the *Fusus subscalarinus* Heilpr. Whorls eight, two embryonic, the balance more or less cancellated; longitudinal costæ somewhat rounded; spiral striæ very numerous, four fine ones between a coarser line; the volutions are appressed at the suture; the spiral striæ cross over the costæ and the coarse lines make nodes of intersections; canal reflected and twisted: the outer lip on the type is broken away but appears to have been smooth internally; inner lip somewhat thickened. Length 17 mm.

Locality.—Pugh's Branch of Satilpa Creek, Clark Co., Ala. Gosport Sand.

Type.—In Ala. Museum, University Ala.

Remark.—One is rather rash to attempt a new form herewith but the surface ornamentation is peculiar and seems to be new.

Cerithiopsis estellensis, n. sp. Pl. 2. Fig. 10.

Shell minute; whorls eleven or more, the first two smooth, the next two with raised ribs; the balance showing two strong, heavily beaded spirals on the peripheral part of each whorl with a third spiral much finer just below the suture ; one or more whorls are missing from the basal part.

Length 3 mm.

Locality.—Sucarnoochee clays, near Estella, Ala.

Type.—In Ala. Museum at University, Ala.

Lævibuccinum (Euryochetus ?) harrisi, n. sp. Pl. 2, Figs. 7-9.

Shell small ; whorls eight, three smooth, the other five below with close-set raised lines ; outer lip smooth, slightly incurved ; inner lip with a callus, thicker and slightly raised on the canal, which is short, rather wide ; shell somewhat truncated anteriorly ; suture distinct. Length of largest specimen 4½ mm.

Locality.—Cave Branch, Ala., about 6 miles east of Thomasville, Ala. Woods Bluff beds.

Type.—Ala. Museum of Nat. Hist., University, Ala.

Remarks.—This shell is quite fragile, the body whorl breaking away from the spire. Prof. Harris figured the spire of this species under *Aesopus erectus* (Proc. Acad. Nat. Sciences, Phila., 1896, p. 476, pl. 21, fig. 3), which it resembles, but later on states it is not the same. The Ala. Museum has three specimens, and there are two broken ones in my cabinet.

Type.—Ala. Museum of Nat. History, University, Ala.

TENUIACTÆON, n. g.

Shell resembling *Actæon* but much more slender ; whorls nine ; aperture small, spire turned to the left and partially immersed ; suture deep ; columella with one fold ; surface with numerous incised revolving lines.

Tenuiactæon pertenuis, n. sp. Pl. 2, Fig. 10.

Shell small, slender ; whorls 9 ; surface with numerous revolving incised lines, stronger at base but almost disappearing at the shoulder of body whorl ; then just below the suture showing two or three stronger ones ; apex rounded and turned to the left, partially immersed ; outer lip somewhat incurved ; base rounded ; columella with one strong fold ; the inner lip reflected over the body whorl ; suture deep, giving each whorl the appearance of being inserted into the next succeeding one. Length 13 mm. ; breadth of body whorl 4 mm. ; aperture 5 mm.

Locality.—Gregg's Ldg. marl at Bell's Ldg. and Gregg's Ldg., Ala. River, Ala.

Type.—Ala. State Museum at University, Ala.

Teredo ringens, n. sp. Pl. 2. Fig. 12.

Shell substance thin, closed at the larger end like *Kuphus* ; body of shell with raised, rather acute rings parallel to each other, and virtually at right angles to the longer diameter. Other fragments are not so stongly marked. Length of type specimen 37 mm. Average breadth 5 mm.

Locality.—Sucarnochee clay bed, 3 miles south of Estelle, Ala.

Type.—Alabama Museum, University, Ala.

Tellina estellensis, n. sp. Pl. 2. Figs. 13, 14.

Shell small, exceedigly thin, exterior smooth, except fine growth lines ; these are stronger near the ventral margin ; inequilateral ; right valve with small laterals, larger in the opposite valve ; pallial sinus large, rounded ; anterior somewhat pointed ; posterior rounded. Length 13-15 mm. ; height 9-11 mm.

Locality.—Sucarnochee beds, near Estelle, Ala.

Type.—Ala. Museum of Nat. History, University, Ala.

Remarks.—This species is the same figured by Prof. Harris (Bulletins Am. Pal., Vol. 1, p. 182) as a cast. It is rather common but so very fragile it was almost impossible to procure a perfect example.

Tellina cynoglossa Dall.

This is the common species in the Woods Bluff beds. It seems to be only a variety of *Tellina subtriangularis* Aldr., which was described from half grown specimens, which is more regularly rounded posteriorly and also lacks the fold seen in older specimens. The full grown examples from Woods Bluff on the Tombigbee River measure as much as 25 mm. in length

Tellina bellsiana, n. sp. Pl. 2. Figs. 15, 16.

Shell large, flat, thin ; nearly equilateral ; surface faintly concentrically striate ; lines growing coarser on the anterior end ;

beaks very small ; the dorsal area strongly bent, pallial area gibbous ; teeth normal. Height about 24 mm.

Locality.—Both Gregg's and Bell's Landings, Ala. River, Ala.

Type.—Ala. Museum of Nat. Hist.

Remarks.—One example in the Carnegie Museum. The type is broken some, shell thin for its size.

Tellina semirotunda, n. sp. Pl. 2. Fig. 17.

Shell medium ; nearly equilateral ; anterior somewhat pointed ; surface smooth, except lines of growth irregularly spaced ; a slightly depressed area extending from beak to base behind the anterior fold. Cicatrices rather large, are well marked ; pallial area large ; cardinals bifid. Length 16 mm. ; height 9 mm.

Locality.—Both Gregg's and Bell's Ldg., Ala. River, Ala.

Type.—Ala. Museum of Natural History.

Tellina semipapyria, n. sp. Pl. 2. Fig. 18.

Shell medium, resembling *Tellina semirotunda nobis ;* surface smooth except growth lines ; pallial sinus large, partially confluent with the pallial line ; only left valve known.

Locality.—Jackson's Rockhouse branch. Woods Bluff beds. Ala. Length 23 mm. ; height 9mm.

Type.—Ala. Museum of Nat. History.

Remarks.—Bears a strong resemblance to the Clabornian species *Tellina papyria* Con. but is somewhat more rotund.

Semele langdoniana, n. sp. Pl. 2. Figs. 19, 20.

Shell oblong, oval ; surface practically smooth, showing very fine lines that are coarser on the umbonal slope ; some specimens show also fine radial lines reaching to the ventral margin ; posterior shortest ; ventral margin entire ; pallial sinus profound. Shell looks like a *Tellina* externally. Length of largest specimen is about 27 mm.

Locality.—Bell's Landing, Monroe Co., Ala. River, Ala.

Type.—(Left valve) Ala. Museum, University Ala.

Remarks.—There are several fragmentary specimens in the lot. This species is named after the late Dr. W. Langdon, an Assistant State Geologist of Alabama and the discoverer of the Floridian Miocene.

Semele monroensis, n. sp. Pl. 2. Figs. 21, 22.

Shell small, rather flat ; one right valve only in the collection ; umbonal slope strongly bent ; surface smooth above with several widely spaced lines towards the ventral margin ; hinge stout ; ligament long for the genus ; the umbonal slope marked interiorly by a few radial lines. Length 5 mm.

Locality.—Bell's Landing, Ala. River, Ala.

Type.—Ala. Museum of Nat. History.

Remarks.—The specimen described is quite young but distinct. Looks like a *Meretrix* in shape and ornamentation.

Lucina primoidea, n. sp. Pl. 2. Figs. 23, 24.

Shell with many raised lines ; beaks recurved, higher than long. This species is figured because it is from an horizon close to the Cretaceous and is doubtless an ancestral form of *Lucina cornuta* Conr. of the Claibornian. The interior is not accessible.

Locality.—Black Bluff, Tombigbee River, Ala., about 20 feet above the base.

Type.—My collection.

Martesia recurva, n. sp. Pl. 2. Figs. 25, 26.

Shell small, short, rotund ; with two accessory plates just forward of the umbones ; groove running nearly vertical from beaks to base and strongly marked ; concentric striæ strongly marked on the posterior end, bending abruptly at the groove and thence running up behind the umbones and under the accessory plates ; the anterior end rounded and smooth ; cardinal margin bordered with a thickened and raised process. Length 8 mm. ; height 4½ mm.

Locality.—Fleming's Mill, Ala., on Pea River. Nanafalia beds.

Type.—My collection.

Remarks.—This species is more obtuse than the usual forms. Three examples found. The interior is not accessible.

Rochefortia minuta, n. sp. Pl. 2. Figs. 27, 28

Shell, small, ovate ; nearly equilateral ; periostracum still adherent, surface showing a few incremental lines ; beaks pointed, with a resiliary pit underneath with short lamellæ on each side, the posterior one the longest ; muscular scar slightly impressed ; the right valve has a space for the left lateral ; pallial line simple. Resembles somewhat *Rochefortia Stimpsoni* Dall. The space in our specimen under the beak looks as though it had been excavated out of the dorsal side, but such is not really the case. Prof. W. H. Dall has examined this specimen, and verified its generic position. Am greatly indebted to him in a number of cases. Length 3 mm. ; height 2 mm.

Locality.—Bell's Ldg., Alabama River, Ala.

Type.—Ala. Museum.

Montacuta bicuspidata, n. sp. Pl. 2. Figs. 29, 30.

Shell minute, oblong-ovate ; surface with incremental lines ; beaks carrying the prodissoconch, nearly central ; viewing the shell from the outside and above, it shows two tooth-like projections, one on each side of the beak, rising from the dorsal margin and another shorter one which does not show like the two first mentioned ; ends rounded ; base arcuate ; hinge with a small subtrigonal tooth and also a space for a lateral in the other valve. Pallial line simple ; adductors distinct but not deep. Length 2¾ mm ; height 2 mm.

Locality.—Bell's Ldg., Ala.

Type.—Ala. Mus. of Nat. History, University, Ala.

Basterotia ? prima, n. sp. Pl. 3. Figs. 1, 2, 3.

Shell small ; valves rather thick ; subquadrangular ; beaks subterminal ; shell profoundly gaping at the anterior ventral part ; a depressed space running from umbo to ventral margin ; surface nearly smooth, showing growth lines which also show in the interior. Anterior adductor scar deep, with a raised border buttressed to hinge plate ; posterior scar slightly impressed, pear-shaped and both rather large for the size of shell ; one cardinal tooth in right valve, corresponding to a deep socket in the other ; a longer tooth below. Three single valves in the collection. Length 8 mm. ; height about 7 mm.

Locality.—Gregg's and Bell's Landings, Ala. River, Ala.

Type.—In Ala. Museum.

Remarks.—This species is doubtfully placed in *Basterotia ;* the large gap suggests an attachment to some other form, but is not irregular. Prof. Dall has kindly examined it, and suggests that it might be commensal.

Saxicavella alabamensis, n. sp. Pl. 3. Figs. 4, 5.

Shell inequivalve ; thin ; posterior much broader than the anterior ; outer surface showing irregular lines of growth, stronger over the umbonal slope ; an upright cardinal tooth directly under the umbo, with a short lateral on posterior side in the right valve ; anterior muscular impression distinct ; pallial line faint. Only one valve in the collection. Length 6 mm. ; height 4½ mm.

Locality.—Bell's Landing, Monroe Co., Ala.

Type.—In Ala. Museum.

Montacuta Herberti, n. sp. Pl. 3. Figs. 6, 7.

Shell small ; inequilateral ; dorsal and ventral margins rounded ; each end rather blunt ; the posterior somewhat angulated ; surface smooth with very fine concentric striations, and a few lines of growth near the ventral margin ; shell inflated ; cardinals feeble, showing in left valve only ; beaks low, rather pointed, a small buttress under them. Length 9 mm ; height 6½ mm.

Locality.—Cave Branch, Ala.

Type.—Ala. Museum of Nat. History.

Remarks.—One valve in my collection. Named in honor of the late Herbert H. Smith.

Ervilia lignitica, n. sp. Pl. 3. Figs. 8, 9.

Shell small, inflated ; nearly inequilateral ; rather solid ; the posterior slightly longer than the anterior ; both ends rounded ; surface carrying a few irregularly spaced grooves of growth; interior polished, shining ; pallial sinus small, not reaching to center ; umbones small, dentition as in the genus with short and strong teeth. Length 6 mm. ; height 3½ mm.

Locality.—Both Gregg's and Bell's Landing beds, Ala. River, Ala.

Type.—Ala. Museum of Nat. History, University, Ala.

Remarks.—This species has a strong resemblance to *Ervilia polita* Dall from the Floridian Pliocene. The young seem to be higher in proportion to their length than the full grown specimens.

Panopea bellsensis, n. sp. Pl. 3. Figs. 10, 11.

Shell rather large, thin, with a brown epidermis ; lines of growth irregularly spaced ; shell compressed, nearly equilateral ; beaks small, appressed to and partly covered by the reflected dorsal margin ; one large cardinal tooth ; ligamental attachment short ; interior porcellaneous with growth lines showing through; pedal scars small. Length 30 mm. ; height about 13 mm.

Locality.—Bell's Ldg., Ala. River, Ala.

Type.—Ala. Museum of Natural History.

Remarks.—One valve and some fragments in the collection. This species has its epidermis preserved. The shell is extremely thin and delicate.

Donax acutangula, n. sp. Pl. 3. Fig. 12.

Shell nearly equilateral ; pointed at both ends, the umbonal slope bent abruptly to almost a right angle in old specimens ; surface nearly smooth ; fine growth lines showing ; ventral margin entire ; beaks small, pointed, smooth ; hinge well developed ; laterals very long, striated on the inner edges. Length about 31 mm. ; height 15 mm.

Locality.—Bell's Landing, Ala. River, Ala.

Type.—Ala. Museum of Nat. History, University Ala.

Remarks.—One whole valve and several fragments of both valves received.

Arca (Cucullaria) ozarkensis, n. sp. Pl. 3. Figs. 13, 14.

Shell small, rounded at both ends, giving the shell a quadrangular outline ; beaks small, compressed and pointed ; surface with rather close set radial lines on the posterior slope ; balance of the surface smooth ; teeth as in the subgenus, three or four anterior and two posterior ; muscular scars shallow but plainly marked. Length 5 mm. ; height 3 mm.

Locality.—Woods Bluff beds near Ozark, Ala.

Type.—My cabinet.

Ostrea intermedoides, n. sp. Pl. 3. Figs. 15, 16.

Shell medium, valves rather thin ; surface in older specimen with numerous raised concentric ribs ; the lower valve bent downwards near the beak ; the umbo shows radial striæ ; margins crenulated internally ; a fragment of the upper valve appears to be flat. Length of lower valve 32 mm. ; breadth about 20 mm.

Locality.—Bell's Landing marl, Bell's Landing, Ala. River, Ala.

Type.—Ala. Museum of Nat. History.

Remarks.—Have hesitated to add another oyster to our Eocene, but I have been unable to find a place for this species. Four lower valves and a fragment of the upper valve are in the collection. The ornamentation recalls *O. falco* Dall from the Jacksonian.

Psammobia Smithi, n. sp. Pl. 3. Figs. 17, 18.

Shell large ; substance of shell thin ; oblong-ovate ; rather compressed ; surface shining, with fine concentric sculpture medially ; both ends coarser and elevated ; on the posterior slope the laminæ are rough and somewhat mammillated ; beaks very small ; muscular scars distinct but shallow. Length 60 mm. ; height 32 mm. ; Breadth about 12 mm.

Locality.—Gregg's Ldg. marl at Bell's Landing, Ala. River, Ala.

Type.—Alabama Museum of Nat. History, University Ala.

Remarks.—Both valves of this splendid species are in the collection. It bears a general resemblance to *P. filosa* Conrad, but the dimensions are very different. Collected by the late H. H. Smith and named in his honor.

Psammobia harrisi, n. sp. Pl. 3. Figs. 19, 20.

Shell nearly equilateral ; truncate behind, with fine concentric sculpture, coarser at each end ; ligamental area short ; cicatrices distinct ; lateral tooth long ; posterior one short. Length about 37 mm.

Locality.—Gregg's Landing, Ala. River, Ala.

Remarks.—This species resembles *P. ozarkana* Harris but is more obtuse. The type is not perfect.

DIVERSA

(Echinocyamus ?) meyeri, n. sp. Pl. 3. Figs. 21, 22.

Test small, ovate ; flattened below ; deeply pitted with ovate scars above which become nearly square on the sides and below ; substance of the test of moderate thickness ; apicial system nearly central ; ambulacral petals relatively short, straight, with numerous round pores. Peristome is medium circular, and slightly depressed ; periproct not small, closer to the peristome than the side. Length 5 mm. ; width 3½ mm. ; height 3 mm.

Locality.—Gosport Sand, Claiborne, Ala.

Type.—My cabinet.

Remarks.—This species is peculiar in the deep pits covering the surface. It is larger than *E. huxleyanus* Meyer and more obese though egg-shaped. Received from Dr. Otto Meyer in whose honor I have named it.

NOTES

BLACK BLUFF OR SUCARNOCHEE HORIZON.

Prof. H. H. Smith and wife collected a number of species from these clays not far from Camden, Ala., in the vicinity of Estelle, Ala. The deposit consists of an aluminous clay, dark chocolate in color, and contains the greater part of the species mentioned by Prof. G. D. Harris from the bluff at Fort Gaines on the Chattahoochee River where they seem to be represented principally by casts. Those near Estelle are rather numerous, but very fragile. A few new species are described in this paper.

A surprising fact is that a minute *Corbula*, *Corbula* (*Aloidis*) *milium* Dall, originally described from the Wilcoxian is extremely common. The supposed differences in the specific fauna is explained. The two localities are over 100 miles apart. The list of species from near Estelle is as follows :

Leda saffordana Harris.
“ *parva* Rogers.
“ *quercollis* Harris.
“ *milamensis* “
Corbula (*Aloidis*) *milium* Dall.
Glycymeris cf *aviculoides* Con.
Pinna sp. ?
Teredo ringens Aldr.
Yoldia eborea Con.
Venericardia wilcoxensis Dall.
Tellina estellensis Aldr.
Protocardia Harrisi Dall.
Pecten alabamensis Aldr.
Ostrea ? young.
Nucula ovula Lea.
“ *mediavia* Harris.
Modiola saffordi Gabb.
Meretrix ripleyana Gabb.
Cucullæa saffordi Gabb.
“ *macrodonta* Whitf.
Crassatellites sepulcollis Harris.
“ *gabbi* Safford.
Arca sp. ?
Corbula subcompressa Gabb.
Strepsidura Heilprini Aldr.
Volutilithes rugatus Con.
“ *limopsis* Con.
Turritella tennesseensis Gabb.
“ *mortoni* Con.
“ *humerosa* Con.
Turritella alabamiensis Whitf.

Triton showalteri Con.
Solarium periscelidum Dall.
Solariella alabamensis Ald.
Rissoina alabamensis Ald.
Pseudoliva unicarinata Ald.
  “ *scalina* Heilpr.
Pleurotoma quercollis Harris.
  “ *persa* Whitf.
  “ *mediavia* Harris.
  “ *adeona* Whitf.
  “ *longipersa* Harris (var.)
Calyptraphorus velatus, var. *compressus* Aldr.
Olivella mediavia Harris.
Natica saffordia ? “
  “ *reversa* Whitf.
  “ *onusta* “
  “ *eminula* Con.
  “ *limula* “
Amaura tombigbeensis Harris.
Mesalia watsonensis Harris.
  “ *pumila* Gabb (var.)
  “ *alabamiensis* Whitf.
Levifusus pagoda Heilpr.
  ‘ *dalei* Harris.
Fusus quercollis Harris.
  “ *ottonis* Aldr.
  “ *tortilis* Whitf.
  “ *mohri* Aldr.
Dentalium mediaviense Harris.
Cadulus turgidus Mr.
Atys robustoides Aldr.
Tornatella quercollis Harris.
Cylichna meyeri Aldr.
Gilbertia estellensis Aldr.
Cypræa 2 sp.

Exilia pergracilis Con.
Nautilus sp. Fragments.

Flabellum conoideum Vaughan.
Balanophylla haleana M. Ed. & H.
Stenocyathus n. sp.

Foraminifera, 12 species.

EXPLANATION OF PLATE 1

Figure			Page
1.	*Mitramorpha turriculata*, n. sp., Choctaw Cor.	Length 6 mm...	5
2, 3.	*Turris nodoideus*, n. sp., Cave Branch	9 mm...	5
4, 5.	*Turris specus*, n. sp., Cave Branch	8 mm...	6
6.	*Turris bimoniatus*, n. sp., Cave Branch	14 mm...	7
7, 8.	*Pleurotoma* (*Peratotoma*) *Gardneri*, n. sp., Pugh's Br.	21 mm...	8
9.	*Odostomia* (*Evalea*) *Bartschi*, n. sp., Bell's Ldg.	3 mm...	8
10.	*Turbonilla* (*Ptycheulimella*) *clinensis*, n. sp., Gregg's Landing	3 mm...	9
11.	*Turbonilla* (*Cingulina*) *tuscahomensis*, n. sp., Gregg's Landing	4 mm...	9
12.	*Turbonilla* (*Ptycheulimella*) *tardiusculus*, n. sp., Cave Branch	4.5 mm...	9
13.	*Pyramidella* (*Iphiana*) *obtusoides*, n. sp., Gregg's Ldg.	3.5 mm...	10
14.	*Epitonium munistriatum*, n. sp., Jackson's Rock House Branch	4 mm...	10
15.	*Epitonium munistriatum*, n. sp., Gregg's Landing	3 mm...	10
16.	*Epitonium multiliniferum*, n. sp., Cave Branch	10 mm...	11
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19, 20.	*Teinostoma subangulata* Mr., var. *Smithi*, n. var., Bell's Landing	8 mm...	11
21, 22.	*Teinostoma regularis*, n. sp., Pugh's Branch	4 mm...	12
23, 24.	*Ancillopsis Tuomeyi*, n. sp., Bell's Landing	28 mm...	12
25, 26.	*Nassa pleona*. n. sp., Lisbon	12+ mm...	12
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29.	*Cancellaria Gilberti*, n. sp., Gregg's Landing	9 mm...	13
30.	*Ovula regularoides*, n. sp., Bell's Landing	14 mm...	14

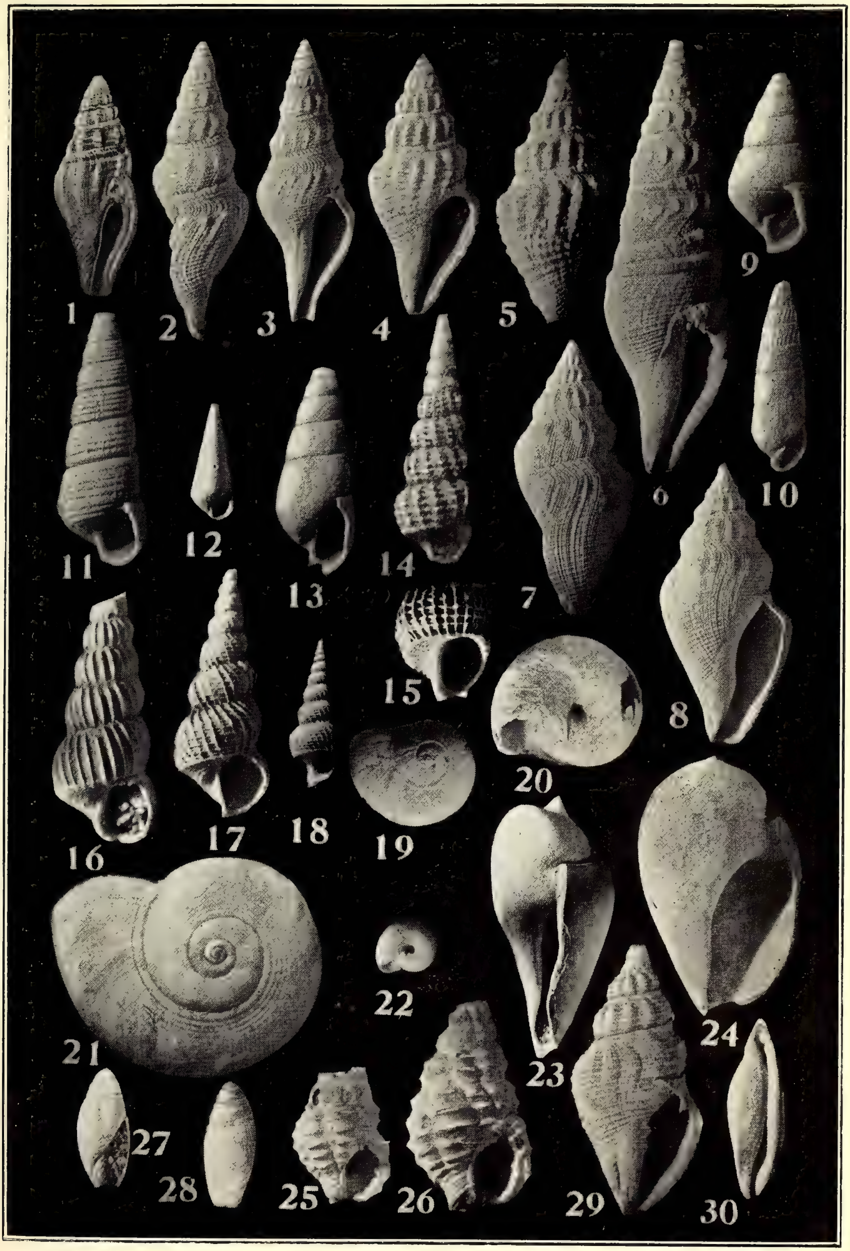
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PLATE 2

(2)

EXPLANATION OF PLATE 2

Figure			Page
1.	*Cypræa estellensis*, n. sp., Pursley Cr.	12 mm.	14
2, 3.	*Cypræa* sp., Pursley Cr.	15 mm.	15
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11.	*Cerithiopsis estellensis*, n. sp., Estelle	3 mm.	15
12.	*Teredo ringens*, n. sp., Estelle	37 mm.	17
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15, 16.	*Tellina bellsiana*, n. sp., Bell's Ldg. ; height	24 mm.	17
17.	*Tellina semirotunda*, n. sp., Gregg's Ldg. ; length	16 mm.	18
18.	*Tellina semipapyria*, n. sp., Jackson's Rockhouse Branch ; length	23 mm.	18
19, 20.	*Semele langdoniana*, n. sp., Bell's Ldg.	27 mm.	18
21, 22.	*Semele monroensis*, n. sp., Bell's Ldg.	5 mm.	19
23, 24.	*Lucina primoidea*, n. sp., Black Bluff	9x9x6 mm.	19
25, 26.	*Martesia recurva*, n. sp., Fleming's Mill, Nanafalia beds	8x4.5 mm.	19
27, 28.	*Rochefortia minuta*, n. sp., Bell's Ldg.	3 mm.	20
29, 30.	*Montacuta bicuspidata*, n. sp., Bell's Ldg.	2x2¾ mm.	20

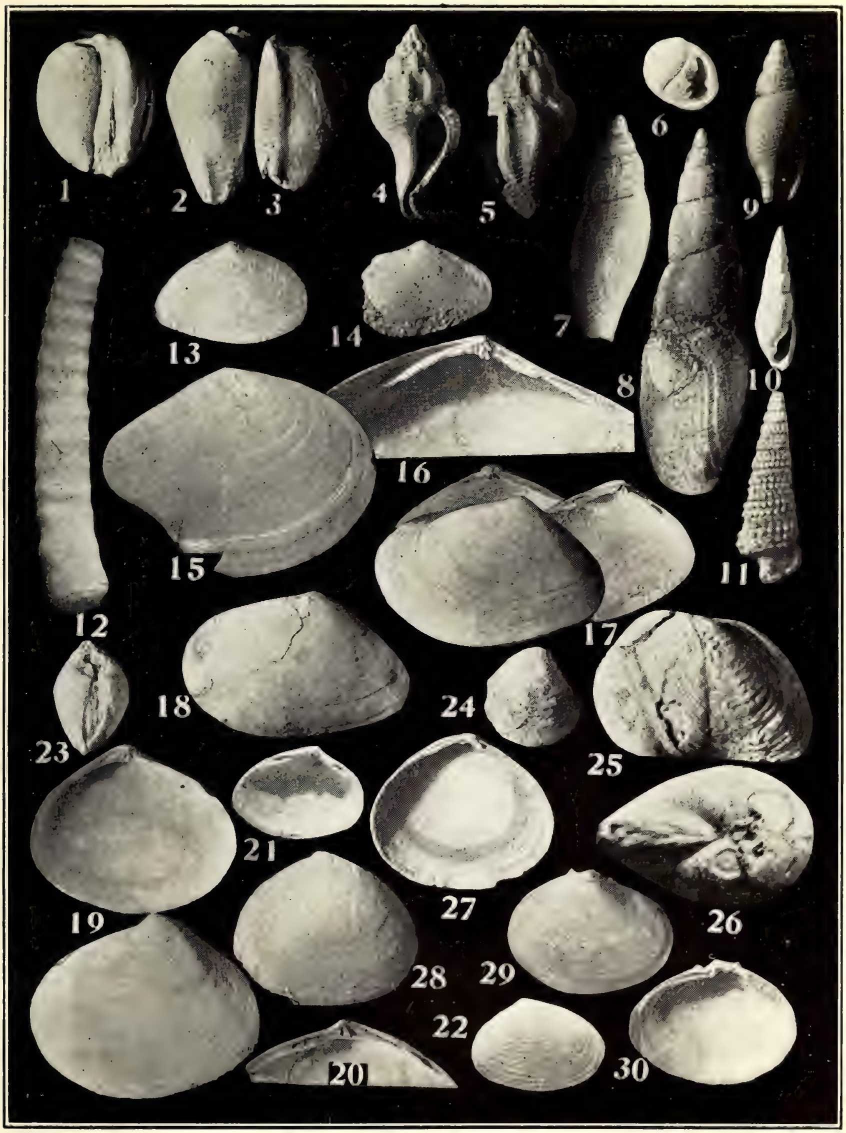
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PLATE 3

(3)

EXPLANATION OF PLATE 3

Figure			Page
1, 2, 3.	*Basterotia ? prima*, n. sp., Gregg's Ldg.	8x7 mm.	20
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6, 7.	*Montacuta Herberti*, n. sp., Cave Br.	9 mm.	21
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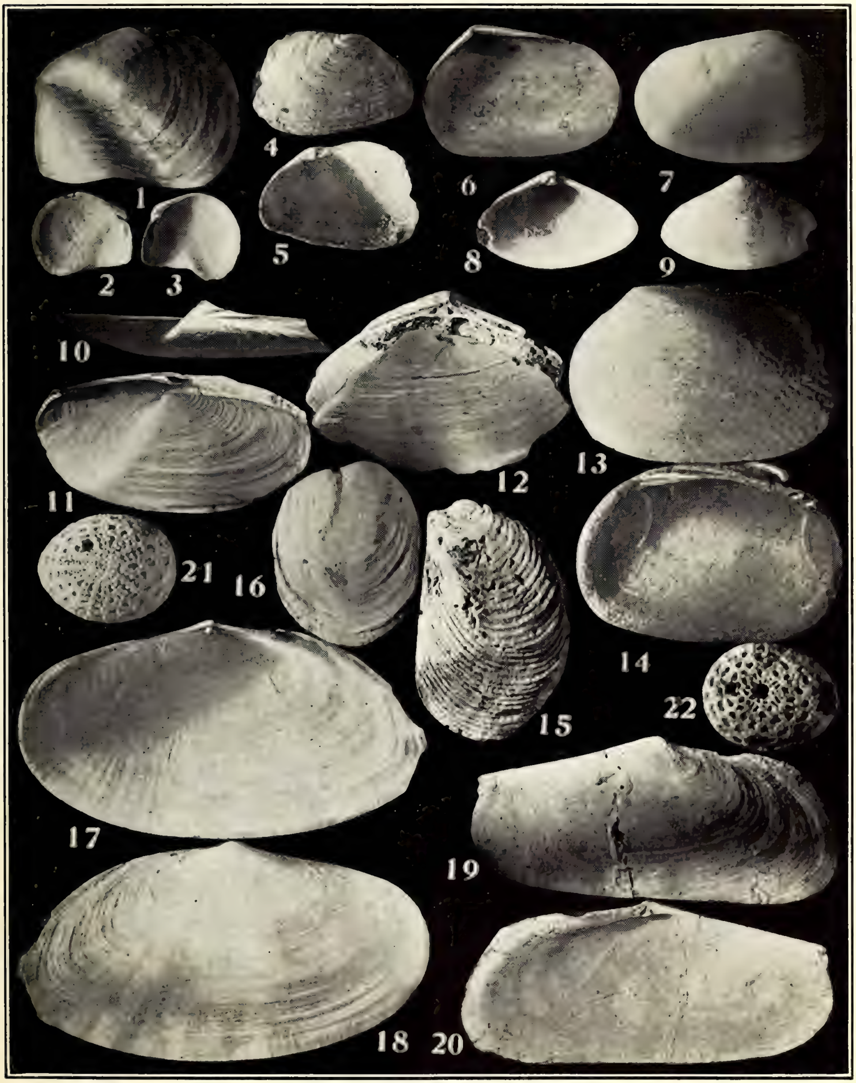
13, 14.	*Arca* (*Cucullaria*) *ozarkensis*, n. sp., near Ozark	5x3 mm.	22
15, 16.	*Ostrea intermedoides*, n. sp., Bell's Ldg.	No. 15, 24x19 mm. No. 16, 32x22 mm.	23
17, 18.	*Psammobia Smithi*, n. sp., Bell's Ldg.	60x32 mm.	23
19, 20.	*Psammobia harrisi*, n. sp., Gregg's Ldg.	37 mm.	24
21, 22.	(*Echinocyamus ?*) *meyeri*, n. sp., Claiborne	5x3½x3 mm.	24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Part 2

Scaphopoda, Gastropoda, Amphineura, Cephalopoda

BY

CARLOTTA JOAQUINA MAURY

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[Part I, PELECYPODA is Bulletin No. 34, 1920.]

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CLASS SCAPHOPODA

ORDER SOLENOCONCHA

Genus **DENTALIUM** Linnæus

laqueatum Verrill, Trans, Conn., Acad, Arts Sci., vol. 6. pt. 2, p. 431, pl. 44, f. 18, 1885; Dall, Bull. Mus. Comp. Zool., 18, pt. 2, p. 426, pl. 27, f. 1, 1889; Bull, 37, U. S. Nat. Mus., p. 76, pl. 27, f. 1; pl. 46, f. 18, 1889; Pilsbry and Sharp, Tryon's Man. Conch., 17, p. 10, pl. 7, f. 1, 2; pl. 5, f. 73, 1897, Henderson, Bull. 111, U. S. Nat. Mus., p. 23, pl. 1, f. 6, 7, 1920.

Distribution—Hatteras to Barbados, Gulf of Mexico: West Florida and off the Mississippi delta, 60-68 fms.

texasianum Philippi, Zeitschr. Malak, p. 144, 1848; Pilsbry & Sharp, Tryon's Man. Conch., 17, p. 22, 1897; Henderson, Bull. 111, U. S. N. M., p. 28, pl. 1, f. 2, 4, 5, 9, 1920.

sexangulare Hilgard, House of Rep. Ex. Doc. 1, pt. 2, pp. 887, 888, pl. 3, f. 7, 1878. Not of Lamarck.

gouldii Singley, 4th Ann. Rept. Texas Surv., p. 331, 1892; Dall, List Cameron Sh. Not the true *gouldii* of Dall.

Note.—This may be identical with Chenu's *D. americanum* 1843. Closely related to *gouldii* Dall, with which it has been confused.

Distribution.—N. Carolina to Yucatan, 3-9 fms. Gulf coast: Point au Fer and Cameron, La.; Galveston, Corpus Christi and Pass Cabello, Tex. Pleistocene, Lake Borgne borings, La.

texasianum cestum Henderson, Bull, 111, U. S. N. M., p. 29, pl. 2, f. 1, 4, 8, 1920.

Distribution.—Pass Cabello, Texas. Probably in very shallow water.

rebeccaensis Henderson, Bull. 111, U. S. N. M. pp. 16, 31, pl. 3, f. 2, 1920.

Distribution.—West Florida, 7-16 fms. and the Tortugas.

(**Antalis**) **antillarum** d 'Orbigny, In de la Sagra's, Hist Pol. y Nat. Isla de Cuba, 2, p. 202, pl. 25, f. 10-13, 1846; Pilsbry & Sharp, Tryon's Man. Conch., 17, p. 57, pl. 14, f 22-25, 1897; Henderson, Bull. 111, U. S. N. M., p. 44, pl. 5, f. 1-4, 6-8, 1920.

Note.—Confined to shallow water. Deep water citations are referable to different species.

Distribution.—Florida to Barbados. Gulf Coast: Charlotte Harbor and other stations off West Florida, 2-14 fms.

(**Antalis**) **pseudohexagonum** Ihering. See Henderson Bull. 111, U. S. N.M., p. 46, pl. 6, f.1-3,1920.

Distribution.—Florida to Brazil. Gulf coast: Marco, Tampa and Charlotte Harbor, West Florida, 2-5 fms.

(**Antalis**) **disparile** d' Orbigny, Hist. Pol. y Nat. Isla de Cuba, 2, p. 202, pl. 25, f. 14-17, 1846; (?) Vanatta, Proc. Acad. N. S. Phila, 55, p. 757, 1903; Henderson, Bull. 111, U. S. N. M., p. 47, pl. 6, f. 4-8, 1920.

Note.— Frequently confused with *D. antillarum* by authors although really closer to *texasianum*.

Distribution.—Florida to Rio de Janeiro, Brazil. Gulf coast; Tampa, Fla. Littoral zone.

(**Antalis**) **ceratum** Dall, Bull. Mus. Comp. Zool., 9, p. 38, 1881; *Idem*, 18, p. 424, pl. 26, f. 5, pl. 27, f. 2, 1889; Bull. 37, U. S. N. M., p. 76, pl. 26, f. 5, 1889: Henderson, Bull. 111, U. S. N. M. pp. 49-51, pl 7, f. 2-7, 1920.

Distribution—Florida to Barbados. Gulf of Mexico: Off Mississippi delta, 321 fms.; Yucatan Banks, 84 fms.

(**Antalis**) **taphrium** Dall, Bull. M. C. Z., 18, p. 422, 1889; U. S. N.M.,p. 76, 1889; Pilsbry & Sharp, Tryon's Man. 17, p. 58, 1897; Henderson, Bull. 111, U. S. N. M., p. 53, pl. 7, f. 8 1920.

Distribution—Hatteras to Cuba, 22-182 fms. Type dredged between Mississippi delta and Cedar Keys in 30 fms.

(**Antalis**) **bartletti** Henderson, Bull. 111, U. S. N. M., p. 55, pl. 8, f. 2,7, 1920.

antillarum Dall, Bull. M. C. Z., 9, p. 37, 1881; Bull. 37, U. S. N. M., p 76 (*pars*), 1889. Not *antillarum* d'Orbigny, 1846.

Note.—True *antillarum* is semi-littoral while *bartletti* is in deeper, colder waters.

Distribution.—Florida to Martinique. Gulf of Mexico: Between Mississippi delta and Cedar Keys, 227 fms.; Yucatan Banks, 399 fms.

(**Heteroschisma**) **callithrix** Dall, Bull. M. C. Z., 18, p. 427, pl. 27, f. 10, 1889; Bull. 37, U. S. N. M., p. 76, pl. 27, f. 10, 1889; Pilsbry & Sharp, Tryon's Man. Conch 17, p. 62, pl. 7, f. 3, 1897; Henderson, Bull. 111, U. S. N. M., p. 57, pl. 8, f. 3, 4, 6, 1920.

Distribution—North Carolina to off Rio de la Plata, Argentina. Gulf of Mexico: Between Mississippi delta and Cedar Keys, 1181 fms.; Yucatan Strait, 640 fms. (type locality).

(**Fissidentalium**) **meridionale** Pilsbry and Sharp, Tryon's Man. Conch., 17, p. 73, pl. 15, f. 32-34, 1897, (as variety of *candidum*); Henderson, Bull. 111, U. S. N. M., p. 61, pl. 9, f. 2, 1920.

ceras Dall, Bull. M. C. Z. 9, p. 37, 1881; 18, p. 425, 1889; Proc. U. S. N. M. 12, p. 294, 1889. Not *ceras* Watson.

Distribution—Type dredged by the Albatross, 240 miles southeast of Rio de Janeiro, 671 fms., 37° temperature bottom. Also found Yucatan Banks, 1568 fms. and off Barbados. The largest *Dentalium* of the western Atlantic and characterized by its unique, ashen color.

(**Graptacme**) **eboreum** Conrad, Proc. Acad. N. S. Phila., 3, p. 27, 1846; Pilsbry and Sharp, Tryon's Man. Conch., 17, p. 89, pl. 16, f. 47-49, 55, 56, 1897; Henderson, Bull. 111, U. S. N. M., p. 66, pl. 10, f. 3-5, 8, 9, pl. 11, f. 6, 1920.

leptum Bush, Trans. Conn. Acad. Arts and Sci., ser. 1, 6, p. 470, pl. 45, f. 18, 18*a*, 1885; Dall, Bull. 37, U. S. N. M., p. 76, 1889.

matara Dall, Bull. M. C. Z., 18, p. 420, 1889; Bull. 37, U. S. N. M., p. 76, 1889.

Distribution.— Hatteras to Barbados. Gulf coast: Sarasota Pass (type locality), Charlotte Harbor, Fla. and between Mississippi delta and Cedar Keys. Beach to 111 fms.

Note.—Mr. Henderson unites *matara* and *leptum* with *eboreum*, noting that *matara* is the perfectly smooth adult form of the species.

(**Graptacme**) **semistriolatum** Guilding, Trans. Linn. Soc. London, 17, pt. 1, p. 34, pl. 3, f. 1-5, 1834; Chenu, Conch. Ill., p. 7, pl. 4, f, 14, 15,,1843; Henderson, Bull. 111, U. S. N. M., p. 69, pl. 11, f. 1-5, 8, 9, 1920.

Distribution.— An abundant littoral species. Florida to Barbados. Gulf coast; West Florida in shallow water, 7-12 fms.

(**Graptacme**) **sericatum** Dall, Bull. M. C. Z., 9, p. 37, 1881; 18, p. 423, pl. 26, f. 1, 1889; Bull. 37, U. S. N. M., p. 76, pl. 26, f. 1, 1889. Henderson, Bull. 111, U. S. N. M., p. 71, pl, 12, f. 1, 6, 1920.

Distribution.—Type only found. Dredged by the *Blake*, 640 fms., Yucatan Banks.

(**Laevidentalium**) **callipeplum** Dall, Bull. M. C. Z., 18. p. p. 419, pl. 27, f. 12 *b*, 1889; Bull. 37, U. S. N. M., p. 76, pl. 27 f. 12 *b*, 1889; Trans. Wagner Inst. Sci., 3, p. 442, 1892; Pilsbry and Sharp, Tryon's Man. Conch., 17, p. 100, pl. 19,

f. 9, 1897; Henderson, Bull. 111, U. S. N. M., p. 74, pl. 12, f. 5, 1920.

Distribution.—Florida to Porto Rico. Gulf of Mexico, dredged to 169 fms. between Mississippi delta and Cedar Keys, (type locality).

(Laevidentalium) perlongum Dall, Bull., M. C. Z., 5, p. 61, 1878, (*nomen nudum*); 9, p. 36, 1881; 18, p. 419, pl. 27, f. 6, 1889; Bull. 37, U. S. N. M., p. 76, pl. 27, f. 6, 1889; Henderson, Bull. 111, U. S. N. M., p. 75, pl. 9, f. 1, 1920.

Distribution.—Hatteras to Rio de la Plata, 11—1330 fms. Gulf of Mexico between Mississippi delta and Cedar Keys at 940 and 1181 fms. also elsewhere in the Gulf at 1330 fms.

(Episiphon) sowerbyi Guilding, Trans. Linn. Soc. London, 17 p. 35, pl. 3, f. 7, 1834; Pilsbry and Sharp, Tryon's Man.' Conch. 17, p. 117, pl. 20, f. 30, 1897; Henderson, Bull. 111, U. S. N. M., pp. 77-80, pl. 13, f. 2, 3, 10, 1920.

filum Dall, Bull. 37, U. S. N. M., p. 76, 1889. Probably not *filum* of Sowerby, 1860, which was from the east Atlantic.

Distribution.—Hatteras to Barbados. Gulf of Mexico: Off Mobile, Ala., 27 fms.; between Mississippi delta and Cedar Keys, 60 fms.

sowerbyi pelliceri Henderson, Bull. 111, U. S. N. M., p. 80, pl. 13, f. 7, 8, 9, 1920.

Distribution.— Florida to Cuba, Cape Catouche, Yucatan, 25 fms.

(Bathoxiphus) ensiculus Jeffreys, Ann. and Mag. Nat. Hist. ser. 4, 19, p. 154, 1877; Proc. Zool. Soc., p. 660, pl. 49, f. 4, 1882. Watson, Challenger Rept., (Scaphopoda), p. 12, pl. 2, f. 2, 1885; Dall, Bull. 37, U. S. N. M., p. 76, 1889; Henderson, Bull. 111, U. S. N. M., p. 81, pl. 14, f. 1, 4, 5, 7, 9, 1920.

Distribution.—East and West Atlantic. A deep.water species of wide range. Gulf of Mexico: Yucatan Strait, 640 fms.

(Bathoxiphus) didymum Watson, Jour. Linn. Soc. London, 14, p. 517, 1879; Henderson, Bull. 111, U. S. N. M., p. 83, pl. 14, f. 10, 1920.

Distribution.--Culebra Isl. and Barbabos. Doubtful specimen, Yucatan Banks, 25 fms.

(Compressidens) pressum Pilsbry and Sharp, Tryon's Man. Conch. 17, p. 124, pl. 7, f. 11; pl. 22, f. 50-52, 1897; Henderson, Bull, 111, U. S. N. M., p. 83, pl. 14, f. 3, 6, 8, 1920.

compressum Watson, Jour. Linn. Soc. London, 14, p. 516, 1879; Dall, Bull. M. C. Z., 9, p. 38, 1881; Watson, Chall. Rept. (Scaph.), p. 9, pl. 1, f. 9, 1885; Dall, Bull. 37, U. S. N. M., p. 76, 1889. Not *compressum* of d'Orbigny, 1850.

Distribution.—Florida to the Antilles. Gulf of Mexico: Off Cedar Keys, 196 fms.; between Mississippi delta and Cedar Keys, Fla.

(Compressidens) ophiodon Dall, Bull. M. C. Z., 9, p. 38, 1881; 18, p, 427, pl. 26, f. 9, 1889; Bull. 37, U. S. N. M., p. 76,pl. 26, f. 9, 1889 ; Henderson, Bull. 111, U. S. N. M., 84, pl. 14, f. 2, 1920.

Distribution.—Florida to Barbados. Gulf of Mexico: West Florida, 169 fms.

quadrangulare Harris, Bull. Amer. Paleontology, vol. 1, p. 95, 1895. Upper Miocene, Galveston well at 2465-2871 feet (Harris).

tetragonum Sowerby, Thesaurus Conch., 3, p. 103, pl. 224, f. 21, 22, 1860. Upper Miocene, Galveston well, at 2158-2920 feet (Harris).

Remark.—A fragment of an undetermined, Pleistocene, *Dentalium* was obtained from Knapp's No. 2 well, Terrebonne Parish, La. at 1190-1430 feet.

Genus **CADULUS** Philippi

(Polyschides) quadridentatus Dall, Bull. M. C. Z. 9, p. 36, 1881; 18, p. 428, pl. 27, f. 5, 1889; Bull. 37, U. S. N. M., p. 76, pl. 27, f. 5, 1889; Henderson, Bull. 111, U. S. N. M., pp. 97-100, pl. 17, f. 2, 3, 1920.

incisus Bush, Tr. Conn. Acad., 6, p. 471, pl. 45, f. 20, 1885; Dall, Bull. 37, U. S. N. M., p. 76, pl. 41, f. 20, 1889.

Distribution.—Hatteras to Rio de la Plata, 3-52, fms. Gulf of Mexico: West Florida, 10-25 fms.; Yucatan Banks 25 fms.

(Polyschides) carolinensis Bush. In Verrill, Rept. Fish Com. (for 1883), p. 587, 1885; Tr. Conn. Acad., 6, p. 471, pl. 45, f. 19, 1885; Dall, Bull. 37, U. S. N. M, p. 48 (*pars*), pl. 41, f. 19, 1889; Pilsbry and Sharp, Tryon's Man. Conch., 17, p. 152, pl. 25, f. 64, pl. 30, f. 241-127, 1898; Henderson, Bull. 111, U. S. N. M., p. 102, pl. 17, f. 6, 7, 1920.

Distribution.—Hatteras to Key West, 3-87 fms. Gulf of Mexico, off Mobile, in 27 fms.

(Platyschides) poculum Dall, Bull., M. C. Z,, 18, p. 429, 1889; Bull. 37, U. S. N. M., p. 76, 1889 ; Pilsbry and Sharp, Tryon's Man. Conch., 17, p. 172, pl. 33, f. 56, 57, 1898 ; Henderson, Bull. 111, U. S. N. M., p. 108, pl. 17, f. 8,1920.

Distribution.— Type found off St. Vincent, W. I., 424 fms. Also dredged, 640 fms., Yucatan Banks.

(Platyschides) parvus Henderson, Bull. 111, U. S. N. M., p. 113, pl, 18, f. 2, 4, 1920.

amiantus Dall, Bull. 37, U, S. N. M., p. 78, 1889. Not Dall's typical *amiantus*.

Distribution.— Off Barbados, 100 fms. (type) ; Yucatan Banks, 1002 fms.

(Platyschides) elongatus Henderson, Bull. 111, U. S. N. M., p. 122, pl. 19, f. 15, 1920.

Distribution.—Gulf of Mexico, off the mouth of the Mississippi River, 68 fms.

(**Platyschides**) **arctus** Henderson, Bull. 111, U. S. N. M., p. 124, pl. 19, f. 19, 1920.

Distribution.—Gulf of Mexico off Cape San Blas, Florida, 60 fms.

(**Gadila**) **mayori** Henderson, Bull. 111, U. S. N. M., p. 133, pl. 19, f. 3, 1920.

Distribution.—Florida, Gulf of Mexico, off Cape San Blas, Fla., 60 fms.

(**Cadulus**) **transitorius** Henderson, Bull. 111, p. 143, pl. 19, f. 6, 1920.

Distribution.—Florida to Old Providence Isl.,north of Colon. Gulf of Mexico, off Cape San Blas, Fla., 196 and 169 fms.

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CLASS GASTROPODA

ORDER PTEROPODA

Genus CAVOLINA Abildgaard

inflexa Lesueur Nouv. Bull. Soc. Philom., 3, p. 285, pl. 5, f. 3, 1813, (as *Hyalæa*); Dall, Bull. U. S. Nat. Mus., 37, p. 82, 1889; Proc. U. S. Nat. Mus., 37, p. 197, 1910.

Distribution.—West Atlantic, Lat. 42°N.—42° S., East Pacific, Lat. 13° N.—42° S. Gulf of Mexico, West Florida. Pelagic. Pleistocene to Recent.

uncinata Rang, in d'Orbigny's, Voy. Ame'r Me'r., p. 93, pl. 5, f. 11-13, 1836, (as *Hyalæa*); Dall Bull. 37, U. S. N. Mus., p. 82, pl. 66, f. 116, 1889; Proc. U. S. N. Mus. 37, p. 198, 1910; Johnson, Occ. Papers, Boston Soc. Nat. Hist., 7, p. 156, 1915.

Distribution.—West Atlantic, Lat. 40°N.-40°S. East Pacific, Lower California to Ecuador and Galapagos Isls. Gulf of Mexico; West Florida. Pelagic. Pleistocene to Recent.

(Diacria) trispinosa Lesueur, in Blainville; Dict. des Sciences Nat. 22, p. 82, 1821, (as *Hyalæa*); Gould, Inv. Mass., p. 504, 1870, (as *Diacria*); Dall, Bull. 37, p. 82, pl. 66, f. 115, 1889; Sumner, Bull. Bur. Fish., 31, pt. 2, p. 703, 1913. Johnson, Occ. Pap. Bost. Soc., 7, p. 157, 1915.

Distribution.—West Atlantic, Lat. 60°N.—40° S. Gulf of Mexico, West Florida. Pelagic. Pleistocene to Recent.

Genus **CLIO** Linnæus

pyramidata Linnæus, Systema Naturæ, 12th ed., p. 1094, 1767; Dall, Bull. 37, U. S. N. M., p. 80, 1889, (as *Cleodora*); Proc. U. S. N. M., 37, p. 198, 1910; Johnson, Occ. Pap. Bost. Soc., 7, p. 158, 1915.

Cleodora lanceolata Souleyet, Zool. Bonite, 2, p. 179, pl. 6, f. 17-25, 1852.

Distribution.—Atlantic, Spitzbergen to Lat. 40° S. Southeastern Pacific, Lat. 27° S. Gulf of Mexico, West Florida and Texas. Pelagic. Pleistocene to Recent.

recurva Children, Jour. Roy. Inst., 15, p. 220, pl. 7, f. 107, 1829, (as *Balantium*); Dall, Bull. 37, p. 82, 1889; Johnson, Occ. Pap. Bost. Soc., 7, p. 158, 1915.

Distribution.—Lat. 40° N.—33° S. Gulf of Mexico, West Florida. Pleistocene to Recent.

Genus **CRESEIS** (Rang) Sowerby

subula Quoy and Gaimard, Ann. des Sci. Nat., ser. 1, 10, p. 233, pl. 8 D, f. 2-3, 1827, (as *Cleodora*); Dall, Bull. 37, p. 80, 1889; Dall and Simpson, Bull. U. S. Fish Com. for 1900, 1, p. 360, pl. 57, f. 1, 1901; Dall, Proc. U. S. N. M., 37, p. 198, 1910; Johnson, Occ. Pap. Bost. Soc., 7, p. 158, 1915, (as *Styliola*); Dall, Bull. 112, U. S. Nat. Mus,, p. 59, 1921.

Distribution.—Atlantic, Lat. 41° N.—40° S. Type locality, Teneriffe. Pacific, Peruvian. Gulf of Mexico, West Florida and Texas. Pelagic. Pleistocene to Recent.

Genus **STYLIOLA** (Lesueur) Gray

virgula Rang, Ann. Sci. Nat., ser. 1, 13, p. 316, f. 2, 1828, (as *Creseis*): Verrill, Trans. Conn. Acad., 5, p. 557, 1882, (as *Styliola*); Dall, Bull. 37, U. S. N. Mus., p. 80, '89, (as *Creseis*); Proc. U. S. N.M., 37, p. 198, 1910 (as *Styliola*); Johnson, Occ. Pap. Bost. Soc., 7, p. 157, 1915, (as *Creseis*).

Distribution.— Atlantic, Lat. 41°N. - 35° S. Pacific, off Juan Fernandez Isl. Gulf of Mexico, West Florida, Pelagic. Pleistocene to Recent.

Genus **VAGINELLA** Daudin

chipolana Dall, Trans. Wagner Inst. Sci., 3, pt. 2, p. 431, pl. 23, f. 4, 5, 1892.

Lower Miocene, Chipola beds, Bailey's Ferry, Calhoun Co., Florida. An ancient, Cretaceous to Recent, genus.

Genus **CUVIERINA** Boas

columnella Rang, Ann. des Sci. Nat., ser. 1, v. 12, p. 323, 1827, Atlas 4°, pl. 45 B, f. 1-8. (as *Cuvieria*); Pelseneer, Challenger Pteropoda,Zool.,23,art. 1, p. 67, 1888; Dall, Bull. 37, U. S. N. Mus., p. 82, pl. 66, f. 117, '89; Tr. Wagner Inst. Sci., 3, pt. 2, p. 431, 1892; Peck, Proc. U. S. N. Mus., 16, p. 462, pl. 55, f. 16, 1893; Dall, Proc. U. S. N. M., 37, p. 198, 1910; Johnson, Occ. Pap. Bost. Soc., 7, p. 159, 1915.

Triptera columnella Verrill, Trans. Conn. Acad., 5, p. 557, 1882; 6, p. 214, 1884.

Distribution.—West Atlantic, Lat. 43° N.—40° S. East Pacific, Lat. 23° N.—42° S. Gulf of Mexico, West Florida and Texas, recent. Lower Miocene Chipola bed at Alum Bluff, Calhoun Co. Florida.

Note.—The specific name is often, but erroneously, written *columella*. The correct form is *columnella* since Rang prints it thus twice in the original description. The generic name *Cuvieria* is preoccupied.

Genus **EMBOLUS** Jeffreys

inflatus d'Orbigny, Voy. Ame'r. Me'r., p. 174, pl. 12, f. 16-19, 1836, (as *Atlanta*); Dall, Bull. 37, U. S. N. Mus., p. 80, 1889; Proc. U.S. N. Mus., 37, p. 199, 1910; Johnson, Occ. Pap. Bost. Soc., 7, p. 155, 1915, (as *Limacina).*

Spirialis rostralis Verrill, Trans, Conn. Acad., 6, p. 431, 1885.

Distribution.—West Atlantic, Lat. 42° N.—40° S. East Pacific. Lat. 42° N.—40° S. Gulf of Mexico, West Florida. Pelagic, Pleistocene to Recent.

Genus **PERACLE** Forbes

reticulata d'Orbigny, Voy. Ame'r, Me'r., p. 178, pl. 12, f. 32-35, 39, 1836, (as *Atlanta*); Dall, Bull. 37, U. S. N. Mus., p. 80, 1889; Proc. U. S. N. Mus., 37, p. 199, 1910.

Distribution.—West Atlantic, Lat. 37° N.—9° S. East Pacific, Lat. 20° S. Mediterranean. Gulf of Mexico, West Florida. Pelagic. Pleistocene to Recent.

ORDER OPISTHOBRANCHIATA

Genus **ACTAEON** Montfort

punctostriatus C. B. Adams, Jour. Bost. Soc. Nat. Hist., 3, p. 323, pl. 3, f. 9, 1840, (as *Tornatella*); Dall, Bull. 37, U. S, N. Mus., p. 84, pl. 41, f. 17, pl. 52, f. 22,'89; Tr. Wagner Inst. Sci., 3. p. 14, '90; Singley, 4th Ann Rept. Geol. Surv. Texas, p. 332, '92; Pilsbry, Tryon's Man. Conch. ser. 1, 15, p. 157, pl. 18, f. 98, 99, pl. 19, f. 22, 23, '93; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 362, 1901; Johnson, Occ. Papers, Bost. Soc. N. H., 7, p. 147, 1915.

punctatus d'Orbigny, In La Sagra, Hist. Pol. y Nat. Isla de Cuba, 1, p. 230, Atlas, pl. 17, f. 10-12, 1842; (as *Tornatella*); Dall, Proc. U. S. N. M., 6, p. 324, 1883. Not *T. punctata* Ferussac, 1823. Not of Lea, 1833. Not of Piette, 1855.

cubensis Gabb, Tr. Amer. Phil. Soc., 15, p. 245, 1873.

Note.—The recent Cuban *Actaon punctatus* d'Orbigny (preoccupied, renamed *cubensis* by Gabb) is now considered identical with the northern *punctostriatus*. *Actæon punctatus* Lea (Contr. Geol, p. 111, pl. 4, f. 96) is Claiborue Eocene, Ala.; and, *fide* Dall, Pliocene; Caloosahatchie beds, Fla. Not Recent.

Distribution.—Cape Cod to the Antilles, 2-63 fms. Miocene (of Shiloh, New Jersey) to Recent. Gulf coast: Cedar Keys, Fla,, Corpus Christi Bay, Tex. Pliocene, Caloosahatchie beds, Fla.

exilis Jeffreys, Ann. & Mag. Nat. Hist., 4th, ser., 6, p. 85, 1870; Watson, Chall. Rept. Gastr., p. 624, '86; Dall, Bull. M. C. Z. Harv. Coll., 18, p. 39, '89; Bull. 37, U. S. N. M., p. 84.

'89; Pilsbry, Man. Conch., 1 ser., 15, p. 156, pl. 19, f. 4-6, '93.

Auriculina insculpta Verrill; Proc. U. S. N, M., 3, p. 381, 1880.

nitidus Verrill, Tr. Conn. Acad., 5, p. 540, pl. 58, f. 21, 1882.

Distribution.—West Atlantic, Martha's Vineyard, Mass. to Florida. Also Mediterranean and Bay of Biscay. 92-1465 fms. Gulf of Mexico, Campeche Bank, at 200 fms. Pliocene to Recent.

pusillus Forbes, Rept. Brit. Assoc. Adv. Sci., p. 191, 1843, (as *Tornatella*); Jeffreys, Ann. & Mag. N. H., 4th ser., 6, p. 84, 5th ser. 10, p, 34; Watson, Chall. Rept. Gastr. p. 627; Dall, Bull. 37, U. S. N. M., p. 84, 1889; Pilsbry, Man. Conch., 1 ser., 15, p. 156, 1893.
An unfigured species.

Distribution.—Mediterranean, Madeira; West Indies. 20-450 fms. Gulf of Mexico, off Sand Key, West Florida, at 111 fms.

perforatus Dall, Bull. M. C. Z., 9, p. 96, 1881; 18, p. 42, pl. 18, f. 3, 89; Bull. 37, U. S. N. M,, p. 84, pl. 18, f. 3, '89; Pilsbry, Man. Conch., 1 ser., 15, p. 159, pl. 20, f. 36, 1893.

Distribution.—Gulf of Mexico, 805 fms.

incisus Dall, M. C. Z., 9, p. 95, 1881; 18, p. 42, pl. 17, f. 1, 1 *b*, '89; Bull. 37, U. S. N. M., p. 84, pl. 17, f. 1, 1*b*, '89; Pilsbry, Man. Conch., 1 ser., 15, p. 161, '93.

Distribution.—Yucatan Strait, off Cape San Antonio, 640 fms. Also off Fernandina, N. E. Fla., 294 fms.

delicatus Dall. Bull. M. C. Z., 18, p. 41, pl. 17, f. 5, 1889: Proc. U. S. N. M., 12, p. 296, '89; Bull. 37, U. S. N. M., p. 84, pl. 17, f. 5, '89: Pilsbry, Man. Conch., ser. 1, 15, p. 162, pl. 20, f. 35, '93.

Distribution.—Gulf of Mexico, West Florida, region. Also Barbabos 73-400 fms.

galvestonensis Harris, Bull. Amer. Pal., vol. 1, p. 96, pl. 3, f. 1, 1895.

Distribution—Upper Miocene, Galveston well at 2552-2871 feet.

Genus **RNIGICULA** Deshayes

nitida Verrill, Am. Jour. Sci., 3, ser., 5, p. 16, 1873; Tr. Conn. Acad., 3, p. 48, pl. 1, f. 2, '74: Dall, Bull. M. C. Z., 18, p. 43, '89; Bull. 37, p. 84, pl. 37, f. 3, '89; Pilsbry, Man. Conch., 1 ser., 15, p. 399, pl. 46, f. 38, '93; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 151, 1915.

leptocheila Brugnone, Misc. Mal., p. 11, pl. 1, f. 17, 1873; Morelet, Jour. de Conch., pp. 131, 285, pl. 5, f. 17, '78; Agassiz, Three Cruises of the Blake, 2, p. 70, f. 291, 1888.

Distribution.—Massachussetts to Pernambuco, Brazil. Also Pliocene of Italy (Brugnone) and recent in the Mediterranean. 19-1075 fms. Gulf of Mexico, Yucatan Strait, 640 fms.

Genus **ACTEOCINA** Gray

bullata Kiener, Sp. et Icon. Coq. Viv., p. 5, pl. 1, f. 4, (as *Tornatella*); Dall, Bull. 37, U. S. N. M., p. 84, 1889; Pilsbry, Man. Conch., 1 ser., 15, p. 183, pl. 50, f. 30, pl. 22, f. 17-19, '93; Harris, Bull. Am. Pal. vol. 1, p. 96, '95; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 362, pl. 57, f. 9, 1901.

Bulla canaliculata d'Orbigny, Hist. Pol. y. Nat. Isla de Cuba, 1, p. 133, pl. 3 bis., f. 21-24. Not of Say.

Tornatina olivula A. Adams, Thes. Conch., 2, p. 569, pl. 121, f. 34.

Distribution.—Florida Strait to Trinidad Island. Upper Miocene, Galveston well at 2410-2425 ft. (Harris).

recta d'Orbigny, In Sagra's Hist. Pol. y. Nat. Isla de Cuba, 1, p. 131, pl. 4, bis. f. 17-20, (as *Bulla*); Dall, Bull. 37, U. S.

N. M., p. 84, 1889; Pilsbry, Man. Conch., 1 ser., 15, p. 184, pl. 22, f. 13-15, '93, (as *Tornatina*); Maury, Bull. Amer. Pal., No. 29, p. 14, pl. 3, f. 3, 1917.

Distribution.—Florida Keys, Antilles and St. Helena. Gulf coast, Tampa. Also Lower Miocene Santo Domingo and Jamaica. A closely related, Older Pliocene, species is *Acteocina wetherilli* Lea, from Deal, N. J. and the Orbitolite bed, Tampa, Fla.

canaliculata Say. Jour. Acad. Nat. Sci. Phila., 5, p. 211, 1822, (as *Volvaria*); Holmes, Post. Pl. Foss. S. Car., p. 78, pl. 12, f. 11, 11a; Gould, Binney' ed., p. 219, f. 510, 1870, (as *Utriculus*); Dall, Proc. U. S. N. M., 6, p. 324, '83; Bull. 37, U. S. N. M., p. 84, pl. 52, f. 27, '89, (as *Tornatina*); Singley, 4th Ann. Rept. Geol. Tex., p. 332, '92; Pilsbry, Man. Conch., 1 ser., 15, p. 184, pl. 22, f. 23, pl. 50, f. 25, 26, '93; Johnson, Occ. Pap. Bost. Soc. N. H., 7, p. 147, 1915; Maury, Bull. Am. Pal., No. 29, p. 13, pl. 3, f. 2, 1917.

obstricta Gould, Silliman's Jour. Sci. 38, p. 196, 1840, (as *Bulla*); Adams. Thes., 2, p. 566, t. 121, f. 29, (as *Tornatina*).

Distribution.—Portland, Maine to Haiti, 0-63 fms. Lower Miocene (Santo Domingo) to Recent. Gulf coast.—Recent: Cameron and Point au Fer, La., (very abundant); Galveston and Corpus Christi, Tex. Pleistocene: North Creek, Manatee and Labelle, Fla.; Grand Chenier, La , Knapp's wells, Terrebonne Parish, No. 2 at 1050-1790 ft., No. 3 at 258-1525 ft. Pliocene; Caloosahatchie River, Fla. Miocene; Gilbert well No. 10, Bateson, Tex., 323 ft.

candei d'Orbigny, Moll. Cuba, 1, p. 128, pl. 4, f. 1-4, (as *Bulla*); Dall, Bull. 37, U. S. N. M., p. 84, pl. 41, f. 13, 1889; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903.

Distribution.—Hatteras to Martinique, 0-48 fms. Gulf coast, St. Joseph's Bay and Crooked Isl., West Fla.

Genus **RETUSA** Brown

frielei Dall, Bull. M. C. Z., 9, p. 101, 1881, (as *Utriculus*); 18, p. 47, pl. 17, f. 4, '89; Bull. 37, U. S. N. M., p. 86, pl. 17, f. 4, '89; Pilsbry, Man. Conch., 1 ser., 15, p. 219, pl. 21, f. 8, 1893.

Note.—I follow Cossmann in placing *Utriculus* Brown, 1827 (not of Schumacher, 1817) in the synonymy of *Retusa*.

Distribution.—Yucatan Strait, 640 fms.

Genus **SCAPHANDER** Montfort

punctostriatus Mighels, Pr. Bost. Soc. N. H., 1, p. 49, 1841, (as *Bulla*); Dall, Bull. 37, U. S. N. M., p. 86, pl. 72, f. 4, '89; Pilsbry, Man. Conch., 1. ser., 15, p. 246, pl. 31 f. 16, '93; Johnson, Occ. Pa. Bost. S. N. H., 7, p. 149, 1915.

librarius Lovén, Index Moll. Scand., p. 10, 1846.

Distribution.—Iceland & Norway to Bay of Biscay. Maine to Barbados, 46-1467 fms. Gulf of Mexico, Lat. 28° N., Lon. 88° W., 533 fms. Inhabits shallow water in its northern habitats.

watsoni Dall, Bull. M. C. Z., 9, p. 99, 1881; 18, p. 52, pl. 17, f. 10, '89; Bull. 37, U. S. N. M., p. 86, pl. 17, f. 10, '89.

Distribution.—Hatteras to Barbados, 54-324 fms. Gulf of Mexico, West Fla. region, dredged U. S. Fish Com., bottom temperature 46° F.

nobilis Verrill, Tr. Conn. Acad. Sci., 6, p. 209, pl. 32, f. 18; Dall, Bull. M. C. Z., 18, p. 53, 1889; Pilsbry, Man. Conch., 1 ser., 15, p. 249; '93.

Distribution.—Martha's Vineyard 906-1309 fms., Delaware Bay 1091-1209 fms., Tobago 880 fms., Gulf of Mexico, U. S. Fish Com. Station 2127, at 1639 fms.

Genus **SABATIA** Bellardi

bathymophila Dall, Bull. M. C. Z., 9, p. 98, 1881, (as *Atys?*); 18, p. 53, pl. 17, f. 9, 9b, '89; Bull. 37, U. S. N. M., p. 86, pl. 17, f. 9, 9b, '89.

Distribution.—Fernandina to Guadeloupe, 294-1568 fms. Gulf of Mexico, Yucatan Strait, 740 fms.

Genus **CYLICHNELLA** Gabb

bidentata d'Orbigny, Moll. Cuba 1. p. 125, pl. 4, f. 13-16, 1841, (as *Bulla*); Gabb, Pr. A. N. S. Phila., 24, p. 273, pl. 10, f. 2, '72; Dall, Bull. 37, U. S. N. M., p. 86, pl. 41, f. 14, '89; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903.

Bulla biplicata Lea. Pr. Bost, Soc. N. H., 1, p. 204, 1844.

Distribution.—Hatteras to Barbados, 7-168 fms. Pliocene to Recent. Gulf coast, Recent: West Florida and Texas. Pleistocene, Louisiana, Knapp's No. 2 well, Terrebonne Parish, 1519-1542 ft., Crowley No. 4 well, Jennings, 1663-1670 feet.

bidentata var. **galvestonensis** Harris, Bull. Am. Pal., vol. 1, p. 96, pl. 3, f. 2, 1895.

Distribution.—Upper Miocene, Galveston well at 2600-2733 feet.

Genus **BULLARIA** Rafinesque

striata Bruguiere, Ency. Meth., 1, p. 572, (as *Bulla*); Dall, Bull. 37, U. S. N. M., p. 88, 1889; Pilsbry, Man. Conch., 1, ser., 15, p. 332, pl. 37, f. 42-46, '93.

Distribution.—Recent, Mediterranean and Atlantic coasts of Portugal and Morocco. Also living at Clearwater Harbor, West Florida; New Harbor Isls. and Chandeleurs, Louisiana; Texas. Pliocene, Caloosahatchie marls, Fla.

occidentalis A. Adams, In Sowerby's Thes., 2, p. 577, pl. 123, f. 72, 73, 1850, (as *Bulla*); Dall, Pr. U. S. N. M., 6, p. 324, '83, Bull. 37, U. S. N. M., p. 88, '89; Singley; 4th Ann.

Rept. Geol. Surv. Tex., p. 332, '92; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903.

Distribution.—Florida to St. Vincent, W. I. Gulf coast: Cedar Keys, St. Marks, Tampa, Crooked Isl (Calhoun Co.), Fla.; Corpus Christi and Matagorda Bays, Texas.

solida Gmelin, Syst. Nat., 13, p. 3434, (as *Bulla*); Dall, Bull. 37, U. S. N. M., p. 88, 1889; Pilsbry, Man. Conch., 1 ser. 15, p. 335, pl. 43, f. 1, 2, 1893.

Distribution.—West Indies, Vera Cruz and Maracaibo. Cited from Texas region, Gulf of Mexico (Dall, '89).

abyssicola Dall, Bull. M. C. Z., 9, p. 97, 1881, (as *Bulla*); 18, p. 56, pl. 17, f. 11, '89; Bull. 37, U. S. N. M., p. 88, pl. 17, f. 11, '89; Pilsbry, Man. Conch., 1 ser., 15, p. 338, pl. 36, f. 31, 1893.

pinguiscula Jeffreys, Ann. & Mag. N. H., p. 318, 1880, (*nomen nudum*); Watson, Chall. Exp. Gastr., p. 638, 1886.

Distribution.—Bay of Biscay, Azores, Antilles and Yucatan Strait, 450-640 fms.

Genus **HAMINOEA** Turton

elegans Gray. Ann. of Philos. new ser. 9, p. 408; 1825; Index Testac., Suppl., pl. 3, f. 2, (as *Bulla*); Pilsbry, Man. Conch., 1 ser., 15, p. 355, pl. 41, f. 37-39, pl. 40, f. 88, 1893; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 364, 1901.

guildingi Swainson, Malacol, pp. 251, 360, f. 46, 1840; Adams, Thes., p. 580, pl. 124, f. 87-89; Dall, Bull. 37, U. S. N. M., p. 88, 1889.

Note.—*Fide* Pilsbry, the true *elegans* of Gray is this species and not a European shell.

Distribution.—Antilles to Rio de Janeiro. Gulf coast, West Florida and Texas.

succinea Conrad, Pr. A. N. S. Phila., 3, p. 26, pl. 1, f. 5, 1846, (as *Bulla*); Dall, Pr, U. S. N. M., 6, p. 324, 1883; Bull. 37, U. S. N. M., p. 88, '89; Mitchell, List Tex. Sh.; Pilsbry, Man, Conch., 1 ser., 15, p. 357, pl. 48, f. 18, 1893; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 364, 1901.

Distribution.—Indian River, E. Fla., to Texas. West Florida at Tampa (Conrad's type locality), and Cedar Keys; Chandeleurs, La.

antillarum d'Orbigny, Moll. Cuba 1, p. 124, pl. 4, f. 9-12; Mœrch, Mal. Bl., 22, p. 175; Dall, Bull. 37, U. S. N. M., p. 88, 1889; Pilsbry, Man. Conch., 1 ser., 15, p. 358, pl. 41, f. 35, 36, 1893; Mitchell, List Texas Shells.

cerina Menke, Zeitschr. fur Mal., p. 142, 1853.

Distribution.—W. Florida to Porto Rico and St. Thomas. Gulf coast at Tampa, Fla., and Espiritu Santo Bay, Texas.

antillarum var. **guadalupensis** Sowerby, Conch. Icon., f. 14, 1868; Pilsbry, Man. Conch., 1 ser., 15, p. 358, pl. 41, f. 30-34, 1893.

Distribution.—Guadeloupe, Cuba &c., Gulf coast at White Water Bay, West Florida.

petiti d'Orbigny, Moll. Cuba 1, p. 130, pl. 4, bis. f. 13-16, (as *Bulla*); Dall, Bull. 37, U. S. N. M., p. 88, 1889: Pilsbry, Man. Conch., 1 ser., 15, p. 359, pl. 41, f. 23, 24, 1893.

Distribution.—St. Thomas, W. I. and Tampa, West Fla.

virescens Sowerby, Genera, No. 39, f. 2; Dall, Tr. W. I. S., 3, p. 18, 1890; Pilsbry, Man. Conch., 1 ser., 15, p. 360, pl. 40, f. 5, pl. 43, f. 19, 1893.

Distribution.—Recent on the Pacific coast, California to Mexico. Pliocene, Caloosahatchie beds, Fla. Not in the recent Atlantic fauna.

Genus **CYLINDROBULLA** Fischer

beaui Fischer, Jour. de Conch., p. 275, pl. 8, f. 8, 9, 1856; Dall, Bull. 37, U. S. N M., p. 88, 1889; Pilsbry, Man. Conch., 1 ser.,15, p. 380, pl. 42, f. 19, 20, 1893.

Distribution.—Guadeloupe (type locality), St. Thomas, W. I.; Gulf coast at Cedar Keys, 2-95 fms. This species is the genotype.

Genus **HYDATINA** Schumacher

physis Linnæus, Syst. Nat., ed. *x*., p. 727, 1758, (as *Bulla*); Dall, Bull. 37, U. S. N. M., p. 88, 1889; Pilsbry, Man. Conch., ser. 1, 15, p. 387, pl. 45, f. 14-17, 1893; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 364, 1901.

Distribution.—Atlantic, Pacific and Indian Oceans. Gulf coast: Sarasota, West. Fla.

Genus **PHILINE** Ascanius

flexuosa M. Sars, Nyt. Mag. f. naturvidens., 17, p. 181, pl. 11, f. 23-26; Christianiafjordens Fauna, pp. 69, 70, pl. 11, f. 23-26; Dall, Bull. M. C. Z., 18, p. 59, 1889; Bull. 37, U. S. N. M., p. 88, 1889; Pilsbry, Man. Conch., 1 ser., 16, p. 21, pl. 4, f, 86-89, 1896.

Distribution.—Christiania,Norway; Yucatan Strait, 640 fms.

Genus **TETHYS** Linnæus

protea Rang, Hist. Nat. des Aplysiens, p. 56, pl. 10, f. 1-3,1828, (as *Aplysia*): d' Orbigny, Moll. Cuba, 1, p. 117; Beau, Cat. Coq. Guadeloupe, p. 20; Dall, Pr. U. S. N. M., p. 324, '83; Pilsbry, Man. Conch., 1 ser. 16, p. 78, pl. 37, f. 20-22, 1895; Dall & Simpson, Bull. U. S. Fish Com. 1, p. 365, 1901.

Distribution.—Florida to Carthagena, Columbia. Very abundant in the Antilles. Gulf of Mexico, West Florida (Dall).

willcoxi Heilprin, Pr. A. N. S. Phila., p. 364, 1886, (as *Aplysia*); Dall, Bull. 37, U. S. N. M., p. 90, '89; Pilsbry, Man.

Conch., 1 ser. 16, p. 80, pl. 35, f. 30-32, 1895; Johnson, Occ. Pap. Bost. Soc. N. H., 7, p. 154, 1915.

Distribution.—Little Gasparilla Bay and Marco West Florida. Also Massachussetts coast.

ORDER PULMONATA

Genus **AURICULA** Lamarck

(Auriculastrum) pellucens, Menke, Syn. Meth. Moll., p. 131, 1830; Dall, Pr. U. S. N. M., 8, p. 275, pl. 18, f. 8, 1885; Bull. 37, U. S. N. M., p. 90, pl. 47, f. 8, 1889.

Distribution.—Cedar Keys, Florida, to Demerara, British Guiana.

Genus **PEDIPES** Scopoli

mirabilis Muhlfeld, Mag. Ges. Nat. Freude, Berlin, 8, p. 8, pl. 11, f. 13, a. b. 1818; Dall, Bull, 37, U. S. N. M,, p. 92, pl. 47, f. 17, 1889: Dall & Simpson, Bull. U. S. Fish Com., 1, p. 369, pl. 53, f. 8, 1901.

quadridens Pfeiffer, 1839: *ovalis* Adams, 1849, *tridens* Pfeiffer, 1854.

naticoides Stearns, Pr. Bost. S. N. H. 13, p. 108, 1869; Dall, Pr. U. S. N. M., 8, p. 279, pl. 18, f. 17, 1885.

Distribution.—Tampa, Florida, to Guadeloupe Island.

elongatus Dall, Pr. U. S. N. M.,8, p. 279, pl. 18, f. 4, 1885; Bull. 37, U. S. N. M., p. 92, pl. 47, f. 4, 1889.

Distribution.—Marco, Southwest Florida.

Genus **MELAMPUS** Montfort

coffeus Linnæus,Syst. Nat. ed. *x*, p. 729, 1758,(as *Bulla*); Dall, Bull. 37, U. S. N. M., p. 92, pl. 47, f. 3, 1889; Dall & Simpson, Bull. U. S Fish Com. 1, p. 368, pl. 53, f. 13, 1901.

coniformis Bruguiere, Ency. Me'th. 1, p. 339, (as *Bulimus*).

Auricula ovula d'Orbigny, Moll. Cuba 1, p. 187, Atlas, pl. 13, f. 4-7, 1853.

Distribution.—Florida to French Guiana. Pleistocene to Recent. Gulf coast, Cedar Keys, Fla. and Texas.

coffeus var. **gundlachi** Pfeiffer, Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903.

Distribution.—St. Andrews Bay, Washington Co., Fla.

floridanus Shuttleworth, MSS., Pfeiffer, Mon. Aur. Viv., p. 36, 1856; Dall, Bull. 37, U. S. N. M., p. 92, pl. 47, f. 2, 1889.

Distribution.—Tampa to Florida Keys.

flavus Gmelin, Syst. Nat., p. 3436, 1792, (as *Voluta*); Binney, Jour. Bost. Soc., Nat. Hist., 7, p. 166, 1863; Land & Fr. Water Sh. pt. 2, p. 12,'65; Dall, Pr. U. S. N. M., 8, p. 281, pl. 18, f. 2, '85; Bull. 37, U. S. N. M., p. 92, pl. 47, f. 1, '89; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 368, pl. 54, f. 9, 1901; Mitchell, List Texas Shells.

Voluta flava Gmelin, Syst. Nat. p. 3436, 1792.

Bulimus monile Bruguiere, Ency. Me'th., 1, p. 338, 1789.

torosa Moerch, Cat. Yoldi, 38, 1852.

coronatus Adams, 1849; *coronulus* Adams, 1854.

Distribution.—Florida to Guadelonpe. Gulf coast: Tampa, Cedar Keys, Fla.; Point au Fer, La.; Port Lavaca and Espiritu Santo, Tex.

Note.—According to Mr. Mitchell, this species lives near shore, hiding in the day time under drift wood and sea weed and goes in search of food nocturnally.

lineatus Say. Jour. A. N. S. Phila., 1 ser. 2, p. 246, 1822; Dall, Bull. 37, U. S. N, M., p. 92, pl. 47, f. 9, 12, '89; Singley, 4th Ann. Geol. Rept. Texas, p. 352, '92: Johnson, Occ. Pa. Bost. Soc. N· H., 7, p. 178, 1915.

bidentatus Say, Jour. A. N. S. Phila., 1 ser., 2, p. 245, 1822; DeKay, N. Y., Moll., p. 57, pl. 5, f. 92, 1, 2, 3, 1843;

Binney, Land & Fr. W. Sh., 2, p. 10, '65; Not *bidentatus* Montagu, 1803, which is European, but introduced on New England coast.

biplicatus Pfeiffer, Mon. Auric. Viv., p. 21.

Auricula cornea Deshayes, Ency. Me'th., 2, p. 90, 1830; *jaumei* Mittre', 1841.

Distribution.—Maine to Tortola Isl., Gulf coast: Tampa, Cedar Keys, St. Mark's, Fla.; Point au Fer. Chaudeleurs, Belle Isle, La ; Galveston, Tex.

Note.—Northern specimens very distinct; southern grade towards *flavus* with which they may hybridize. Inhabits salt marshes.

(Detracia) bulloides Montagu, Testacea Brit., p. 339, pl. 30, f. 4, 1803, (as *Voluta*); Dall, Pr. U. S. N. M., 8, p. 285, pl. 18, f. 7, 1885; Bull. 37, U. S. N. M., p. 92, pl. 47, f. 7, '89.

Distribution—Cedar Keys, Fla. and the Antilles. Type of Gray's subgenus *Detracia*.

(Sayella) hemphilli Dall, Pr. U. S. N. M., 6, p. 323, pl. 10, f. 6, 1883, (as *Leuconia*); Pr. U. S. N. M., 8, p. 286, pl. 18, f. 11, '85; Bull. U. S. N. M., 37, p. 92, pl. 47, f. 11, '89; Singley, 4th Ann. Rept. Tex. Surv. p. 343, '92.

Distribution.—Cedar Keys, Florida, and Corpus Christi, Texas. Type of section *Sayella* Dall which is intermediate between *Blauneria* and *Detracia*.

(Sayella) crosseana Dall, Pr. U. S. N. M., 8, p.,286, pl. 18, f. 10, '85; Bull. 37, U. S. N. M., p. 92, pl. 47, f. 10, '89; Singley, 4th Ann. Rept. Tex. Surv., p. 343, '92.

Distribution.—West Florida at Egmont Key (Tampa Bay); Corpus Christi, Texas and the Bahamas.

Genus **PLANORBIS** Guettard

ophis Dall, Proc. U. S. N. M., 46, p. 236, pl. 21, f. 3, 4, 1914.

Distribution.—Upper Miocene or Pliocene. Well near Alexandria, La., at 49 feet. Brackish water formation.

Note.—The living species of this fresh water genus are not included in this Synopsis.

Genus **TRALIA** Gray

pusilla Gmelin, Syst. Nat. p. 3436, 1792, (as *Voluta)*; Dall, Pr. U. S. N. M., 8, p. 276, pl. 18, f. 5, '85; Bull, 37, U. S. N. M., p. 92, pl. 47, f. 5, '89; Dall & Simpson, Bull. U. S. Fish Com. 1, p. 369, pl. 54, f. 13, 1901.

triplicata Donovan, 1802; *ovula* Bruguiere, 1789; *nitens* Lamarck, 1822.

Distribution.—Cedar Keys to Guadeloupe.

minuscula Dall, Bull. 37, U. S N. M., p. 92, 1889.

Distribution.—Tampa to Bahamas.

(**Alexia**) **myosotis** Draparnaud, Tabl., p. 53, '01, (as *Auricula*); Dall, Pr. U. S. N. M., 8, p. 277, '85; Bull. 37, U. S. N. M., p. 92, pl. 52, f. 9, '89.

denticulata Montagu, Test. Brit., p. 234, pl. 20, f. 5, '02, (as *Voluta*)

Distribution.—Europe; Jamaica (introduced); West Florida, San Francisco (introduced).

Genus **BLAUNERIA** Shuttleworth

heteroclita Montagu, Test. Brit., Suppl., p. 469, '08, (as *Voluta*); Arango, Moll. Cubana, p. 60, '78; Dall, Pr. U. S. N. M., 8, p. 287, pl. 17, f. 6, '85; Buli. 37, U. S. N. M., p. 92, pl. 47, f. 14, '89, Dall & Simpson, Bull. U. S. Fish Com., 1, p. 369, 1901.

pellucida Pfeiffer, '40, *cubensis* Pfr.

Distribution.—Tampa and Marco, West Florida. Also Antillean.

Genus **SIPHONARIA** Sowerby

alternata Say, Jour. A. N, S. Phila., 5, p. 215, '26, (as *Patella*); Binney, Land & F. W. Sh., 2, p. 153, f. 254, '65; Dall, Pr. U. S. N. M., 8, p. 287, '85; Bull. 37, U. S. N. M,, p. 92, 1889.

Distribution.—The variety *brunnea* Hanley (Pr. Z. S., pp. 21,151,'58)is found at Sarasota Bay. West Fla., and Bermuda.

lineolata d'Orbigny, Moll. Cuba, 1. pl. 17, f. 13-15; Dall, Bull. 37, U. S. N. M., p. 92, '89.

Distribution.—Fernandina, Fla., to Brazil and Texas region of the Gulf of Mexico.

Genns **WILLIAMIA** Monterosato

krebsi Moerch, Dall, Bull. 37, U. S. N. M., p. 92. '89.

Distribution.—West Florida to Barbados.

Fenus **VERONICELLA** Blainville

floridana Binney, Terr. Moll. U. S., 2, pl. 67, f. 17, '51; Dall, Bull. 37, U. S. N. M., p. 90, 1889.

Distribution.—Charlotte Harbor, West Florida to Florida Keys.

Note.—Since Blainville erroneously attributed a shell to this slug-like genus, Ferussac's later name *Vaginula* is often used; but *Veronicella* has priority.

ORDER CTENOBRANCHIATA

Genus **TEREBRA** Bruguiere

cinerea Born, Test. Mus. Vind., p. 267, pl. 10, f. 11, 12, 1780; Tryon, Man., 7, p. 31, pl. 9, f. 67, 1885; Dall, Bull. M. C. Z., 18, p. 63, '89; Singley, 4th Ann. Rept. Tex., p. 332, '92; Dall & Simpson, Bull. U. S. Fish Com., 1, p, 382, 1901.

salleana Deshayes, *jamaicensis* C. B. Adams.

Distribution.—West Indies to Colombia. Gulf coast: Chandeleurs, La., Corpus Christi, Tex. Pleistocene, New Orleans Pumping Station, No. 7.

dislocata Say. Jour. A. N. S. Phila., 2, p. 236, 1825, (as *Cerithium*); Hilgard, House of Rep., Ex. Doc. 1, pt. 2, p. 887, '78; Tryon, Man., 7, p. 18, pl. 4, f. 63, '85; Singley, 4th Ann. Rept. Tex., p. 332, '92; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903.

rudis Gray, *petitii* Kiener. Not *petiti* Maury, 1917.

Distribution.—Maryland to West Indies and Venezuela. Miocene to Recent. Gulf coast Recent; Cedar Keys, Fla.; Chandeleurs, La.; Galveston & Corpus Christi, Texas. Pleistocene of New Orleans pumping station No. 7; New Orleans artesian well of 1856; Lake Borgne borings; Knapp's wells, Terrebonne Parish, No. I at 1600-1700, 2000-2150 ft., No. 2 at 1150-1290, 1731-1739, No. 3 at 1150- 1525 feet. Also of North Creek, Manatee and Labelle, West Fla. Upper Miocene, Galveston well, 2158-2920 ft.

concava Say. Jour. A. N. S. Phila., 5, p. 207, 1827; Dall, Tr. W. Inst. Sci., 3, p, 24, 1890; Singley, 4th Ann. Rept. Tex., p. 332, '92; Harris, Bull. Am. Pal., vol. 1, p. 97,'95.

Distribution.—N. Carolina, Georgia and Texas, at Galveston . Pleistocene of North Creek, Fla. Pliocene, Caloosahatchie, Fla. Upper Miocene, Galveston well at 2552-2920 ft. Note.—The variety *vinosa* Dall (Bull. M. C. Z., 18, p. 64, '89) is found on the Gulf coast at Sarasota Bay and Charlotte Harbor, West Fla.

protexta Conrad, Pr. A. N. S. Phila., 3, p. 26, 1843, (as *Cerithium*); Tryon, Man. 7, p. 25, pl. 6, f. 98, 1885; Dall, Bnll. 37, U. S. N. M., p. 94, '89; Tr. Wagner Inst., 3, p. 25, '90; Dall & Simpson, Bull, Fish Com. 1, p. 382, 1901; Vaughan, Publ. No. 133, Carn. Iust., p. 171, 1910; Maury, Bull. Am. Pal. 29, p. 28, pl. 4, f. 1, 1917.

Distribution.—Hatteras to Texas 2-50 fms. Lower Miocene to Recent. Gulf coast: Cedar Keys & St. Marks, Fla.; Cameron, La.; Galveston, Tex. Pleistocene, North Creek, Manatee and Labelle, Fla.. The variety *lutescens* E. A. Smith, ranges from N. Carolina to West Florida. It is more distinctly reticulated than the typical form.

nassula Dall, Bull. M. C. Z., 18, p. 66, pl. 36, f. 8, 1889; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 383, 1901.

Distribution.—Martinique. Also Gulf of Mexico, Lat. 23° N., Lon. 88° W., at 95 fms.; Yucatan Strait, 640 fms.

limatula Dall, Bnll. M. C. Z., 18, p. 66, 1889; Bull. 37, U. S. N. M., p. 94, '89.

Distribution.—N. Carolina to Barbados. Also Gulf of Mexico between Mississippi delta and Cedar Keys at 111 fms.

texana Dall, Nautilus, 12, p. 45, Aug., 1898; Pr. U. S. N. M., 24, p. 502, pl. 29, f. 8, 1902.

Distribution.—Matagorda Island, Texas. Collected by Hon. J. D. Mitchell. Very rare.

galvestonensis Harris, Bull. Am. Pal., vol. 1, p. 98, pl. 3, f. 5, 1895.

Distribution.—Upper Miocene, Galveston well at 2387-2871 1910.

calhounensis Maury, Bull. Am. Pal., No. 21, p. 4, pl. 1, f. 3, 1910.

Distribution.—Lower Miocene, Chipola marl, Bailey's Ferry, Fla., and Bascom No. 2 well Mobile, Alabama, at a depth of 1241 feet, Chipola horizon.

indenta Conrad, Cited by Mr. Aldrich from the Bascom No. 1 well, Mobile, Ala. at 1500-1556 feet.

langdoni Dall, Pr. U. S. N. M., 18, p. 39, 1895; Tr. W. Inst., 3, pl. 59, f. 27, 1903.

Distribution.—Lower Miocene, Chipola marl, Fla.; Upper Miocene Galveston well at 2158-2920 feet (Harris).

Genus **CONUS** Linnæus

proteus Hwass, Enc. Meth. vers, 1, pt. 2, p. 682, 1789; Reeve, Conch. Icon.,f. 219, *b;* Dall, Bull. 37, U. S. N. M., p. 94, 1889; Vaughan, Publ. No. 133, Carn. Inst., p. 171, 1910; Maury, Bull. Am. Pal. No. 29, p. 42, pl. 6, f. 11, 1917.

leoninus Hwass, 1791, *spurius* auctores, as of Gmelin.

Distribution.—West coast Florida, 19 fms. South to Venezuela. Pliocene, Caloosahatchie River, and Pleistocene, Labelle, Fla.

centurio Born, Mus. Vind., pl. 7, f. 10, 1780; Tryon, Man., 6, p. 33, f. 9, f. 68,'1884: Dall, Bull. M. C. Z., 18, p. 69, '89.

Distribution.—Antilles. Also Gulf of Mexico between Mississippi delta and Cedar Keys at 25 fms.

delessertianus Recluz, Mag. de Zool., pl. 72, 1843; Tryon, Man., 6, p. 33, pl. 9, f. 67, '84; Dall (as *delessertii*) Bull. 37, U. S. N. M., p. 94, '89.

Distribution.—Hatteras to West Florida, 22-63 fms. Doubtful specimen, Porto Rico.

flavescens Gray, Sowerby, Conch. Ill., f. 68; Tryon, Man., 6, p. 36, pl. 10, f. 84, 1884; Dall, Bull. 37, U. S. N. M., p. 94, 1889.

Distribution.—Hatteras to Barbados, and West Florida, 15-170 fms. Pliocene to Recent.

floridanus Gabb, Am. Jour. Conch., 4, p. 195, pl. 15, f. 4, 1868; Tryon, Man. 6, p. 38, pl. 11, f. 4, 5, 1884; Dall, Bull. 37, p. 94, 1889; Tr. W. Inst. Sci., 3, p. 27, 1890.

Distribution.—Hatteras to Florida Keys and West Fla. Pliocene of the Caloosahatchie beds.

peali Green, Tr. Albany Inst., 1, p. 123, pl. 3, f. 3, 1830; Tryon, Man., 6, p. 36, pl. 10, f. 89-92, 1884; Dall, Bull. M. C. Z., 18, p. 68, '89.

stearnsi Conrad, Am. Jour. Conch., 5. p. 104, pl. 10, f. 1, 1869.

Distribution.—Hatteras to Isthmus of Panama. Also Cedar Keys, Florida, 0-5 fms. Pliocene, Caloosahatchie beds.

pygmaeus Reeve, Pr. Z. S., p. 179, 1843; Kiener, Coq. Viv. *Conus*, p. 174, pl. 111, f. 1 a-b, 1848; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 383, 1901.

Distribution.—West Florida to Tobago Isl. Pliocene, Caloosahatchie beds. Pleistocene, North Creek, Fla.

amphiurgus Dall, Bull. M, C. Z., 18, p. 70, 1889.

Distribution.—Coast of Yucatan, 27 fms.

chipolanus Dall, Pr. U. S. N.M., 18, p. 42, 1895.

Distribution.—Lower Miocene, Chipola marls, Florida and of the Bascom No. 2 well, Mobile, Alabama, at 1241 feet.

Genus **TURRIS** Bolten

albida Perry, Conch. Expl., pl. 32, f. 4, 1811, (as *Pleurotoma*); Dall, Bull. 37, U. S. N. M., p. 96, '89; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 384, 1901; Maury, Bull. Am. Pal. No. 29, p. 50, 1917.

Distribution.—Recent, Cedar Keys to Barbados, 26-100 fms. Oligocene of Vicksburg, Miss., and of Tampa, Fla.; Lower Miocene, Western Florida and Santo Domingo; Upper Miocene, Galveston well at 2158-2950 feet.

Note.—The variety *tellea* Dall (Bull. M. C. Z., 18, p. 72, 1889) was dredged in the Gulf of Mexico between Mississippi delta and Cedar Keys.

Genus **LEUCOSYRINX** Dall

verrilli Dall, Bull, M. C. Z., 9, p. 57, 1881, (as *Pleurotoma*); 18,

p. 75, pl. 10, f. 5, 1889; Bull. 37, pl. 10, f. 5, '89.

Distribution.—N. Carolina to Guadeloupe. Also Gulf of Mexico, Lat. 25° N., Lon. 84° W., 888 fms., and between Mississippi delta and Cedar Keys.

sigsbeei Dall, Bull. M. C. Z., 9, p. 57, 1881, (as *Pleurotoma*); 18, p. 76, pl. 11, f. 10, '89; Bull. 37, U. S. N. M., p. 96, pl. 11, f. 10, '89.

Distribution.—Yucatan Strait, 640 fms. Off Bequia, 1591 fms.

tenoceras Dall, Bull. M. C. Z., 18, p. 76, pl. 36, f. 5, 1889; Bull. 37, U. S. N. M., p. 96, pl. 36, f. 5, '89.

Distribution.—N. Carolina to Guadeloupe. Gulf of Mexico between Mississippi delta and Cedar Keys at 724 fms.

subgrundifera Dall, In Agassiz's Three Cruises of the Blake, 2, p. 66, f. 283, 1888, (as *Pleurotoma*); Bull. M. C. Z., 18, p. 77, pl, 38, f. 1, '89; Bull. 37, U. S. N. M., p. 96, pl. 38, f. 1, '89.

Distribution.—Cape Fear, N. C., to St. Kitt's, W. I. Gulf of Mexico, Yucatan Strait, 640 fms., and between Mississippi delta and Cedar Keys, 940 fms., U. S. Fish Com. St. 2384.

Genus **ANCISTROSYRINX** Dall

radiata Dall, Bull. M. C. Z., 18, p. 78, pl. 12, f. 12, 1889; Bull. 37, U. S. N. M., p. 96, pl. 12, f. 12, '89; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 384, 1901.

Distribution.—Gulf of Mexico, Yucatan Strait, 640 fms. and between Mississippi delta and Cedar Keys. Also Antillean.

Genus **GENOTA** Adams

mitrella Dall, Bull. M. C. Z., 9, p. 56, Aug., 1881, (as *Pleurotoma*); 18, p. 78, pl. 12, f. 5, '89; Bull. 37, U. S. N. M., p. 96, pl. 12, f. 5, '89.

didyma Watson, 1881.

Distribution.—Yucatan Strait, 640 fms. Also off Sombrero. W. I.

Genus DRILLIA Gray

ostrearum Stearns, Pr. Bost. Soc. N. H., 15, p. 22, 1872; Tryon, Man. 7, p. 197, pl. 34, f. 79, '84; Dall, Bull. 37, U. S. N. M., p. 96, '89; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 385, 1901.

Distribution.—Hatteras to Cape Catouche, Yucatan and Antilles. 15-170 fms. West Florida: Recent, Cedar Keys; Upper Oligocene, Tampa; Lower Miocene, Chipola beds; Pliocene, Caloosahatchie beds.

albicoma Dall, Bull. M. C. Z. 18, p. 83, pl. 10, f. 8, '89; Bull. U. S. N. M., 37, p. 96, pl. 10, f. 8, 1889.

Distribution.—Gulf of Mexico, Lat. 23° N., Lon. 89° W., 84 fms. Also off Barbados, and St. Thomas.

detecta Dall, Bull. M. C. Z., 9, p. 65, Aug., 1881: 18, p. 84, pl. 12, f. 11, 1889; Bull. 37, p. 96, pl. 12, f. 11, '89.

circumvoluta Watson, Jour. Linn. Soc., 15, p. 465, Nov. 1881; Rept. Chall. Gastr., p. 357, pl. 21, f. 1, 1885.

Distribution.—Gulf of Mexico, 339 fms. Also Culebra Isl, W. I.

alesidota var. **macilenta** Dall, Bull. M. C. Z., 18, p. 85, pl. 36, f. 1, 1889; Bull. 37, U. S. N. M., p. 96, pl. 36, f. 1, '89.

Distribution.—Cape Fear, N. C. to Barbados. Gulf of Mexico between Mississippi delta and Cedar Keys, 111 fms. Typical form of species, off Hatteras.

eucosmia var. **canna** Dall, Bull, M. C. Z., 18, p, 86, 1889; Bull. 37, U. S. N. M., p. 96, '89.

Distribution.—Cape Lookout, N. C., to Grenada, W. I. Also Gulf of Mexico, west of Florida, 50 fms.

leucomya Dall, Proc, U. S. N. M., 6, p. 328, pl. 10, f. 8, 1883; Bull. 37, p. 96, pl. 48, f. 7, 1889; Tr. W. Inst., 3, p. 36, 1890.

Distribution.—Shores of Gulf of Mexico from Sarasota, West Fla., to Yucatan, 3-5 fms. Pliocene, Caloosahatchie beds, Fla.

albinodata Reeve, Zool. Proc., 6, 1846; Tryon, Man., 6, p. 197, pl. 14, f. 5, 1884; Dall, Bull. 37, U. S. N. M., p. 96, '89.

Distribution.—Charlotte Harbor, West Fla., to Santo Domingo.

haliostrephis Dall, Bull. M. C. Z., 18, p. 86, pl. 13, f. 3, 1889; Bull. 37, U. S. N. M., p. 96, pl. 13, f. 3, '89.

Distribution.—Gulf of Mexico, West of Florida, 84 fms.

acestra Dall, Bull. 37, U. S. N. M., p. 96, pl. 10, f. 7, '89.

Distribution.—West Florida to Grenada 161-400 fms.

pharcida Dall, Bull. M. C. Z., 18, p, 88, pl. 12, f. 2, 1889; Bull. 37, p. 96, pl. 12, f. 2, '89.

exasperata Dall. Not of Reeve.

Distribution.—Gulf of Mexico, west of Florida, 229 fms. Also East Fla. to Barbados 150-1002 fms.

tristicha Dall, Bull. M. C. Z.. 18, p. 88, 1889; Bull. 37, p. 98, 1889.

Distribution.—Three stations Gulf of Mexico between Mississippi delta and Cedar Keys, 111-210 fms. Temperature 52°-67° F.

ebur Reeves, Pr. Zool. Soc., p. 116, 1845, (as *Pleurotoma*); Conch. Icon., pl. 30, f. 275, '45; Tryon, Man., 6, p. 188, pl. 13, f. 56, '84; Dall, Bull. 37, U. S. N. M., p. 98, '89.

Distribution.—Hatteras to Sombrero Isl. Also Gulf of Mexico, West of Florida, Blake Station 10, at 34 fms.

pagodula Dall, Bull. M. C. Z., 18, p. 90, pl. 13, f. 6, 1889; Bull. 37, p. 98, pl. 13, f. 6, '89.

Distribution.—Gulf of Mexico, West of Florida, 50 fms. Also Barbados.

thea Dall, Pr. U. S. N. M., 6, p. 328, pl. 10, f. 5, 1883; Bull, M. C. Z., 18, p. 91, '89; Bull. 37, U. S. N. M., p. 98, pl. 48, f. 1, '89.

Distribution.—Hatteras to Florida Keys, and West Florida at Cedar Keys, 3-15 fms.

Note.—The variety *carminura* Dall (Bull. M. C. Z., 18, p. 91, 1889) was dredged in Gulf of Mexico, U. S. Fish Com. Station 2402 at 111 fms.

simpsoni Dall, Pr. Davenport Acad. Sci., 5, p. 54, 1887, (as *Pleurotoma*); Bull. M. C. Z., 18, p. 91, 1889.

Distribution.—Hatteras to Tampa Bay, West Florida, 15-18 fms.

lissotropis Dall, Bull. M. C. Z., 9, p. 58, Ang. 1881; 18, p. 91, pl. 11, f. 3, 4, 1889; Bull. 37, p. 98, pl. 11, f. 3, 4, '89.

hypsela Watson, Jour. Linn, Soc., 15, p. 433, Oct. 1881; Chall. Gastr., p. 341, pl. 21, f. 4, 1885.

Distribution.—Gulf of Mexico, West of Florida at 220 fms. Also Antillean. Variety *perpolita* Dall (Tr. W. Inst., 3, p. 36, '90), Caloosahatchie Pliocene.

dalli var. **cestrota** Dall, Bull. M. C. Z., 18, p. 92, 1889; Bull. 37, p. 98, '89.

Distribution.—Between the Mississippi delta and Cedar Keys, at 196 fms. Typical *dalli* Verrill, ranges from Martha's Vineyard to Delaware Bay.

nucleata Dall, Bull. M. C. Z., 9, p. 62, '81; 18, p. 92, pl. 11, f. 1, 1889.

Distribution.—Gulf of Mexico, 229-339 fms. Also Antillean. *Pleurotoma amblia* Watson may be a synonym.

verrilli Dall, Bull. M. C. Z., 9, p. 68, 1881; 18, p, 93, pl. 11, f. 2, 1889; Bull. 37, p. 98, pl. 11, f. 2, '89.

Distribution.—Gulf of Mexico, West of Florida, 220-310 fms.

havanensis Dall, Bull. M. C, Z., 9, p. 67, 1881; 18, p. 93, pl. 11, f. 5, '89.

Distribution.—Yucatan Strait, 640 fms. Also off Havana.

lithocolleta Watson, Jour. Linn. Soc., 15, p. 441, 1881; Chall. Rept. Gastr., p. 320, pl. 24, f. 6, 1885 (as *Pleurotoma*); Dall, Bull. M. C. Z., 18, p. 95, pl. 11, f. 6, '89; Bull. 37, p. 98, pl. 11, f. 6, '89.

Distribution.—Hatteras to Guadeloupe, W. I. Also Gulf of Mexico between Mississippi delta and Cedar Keys, at 940 fms.

Genus **CYMATOSYRINX** Dall

centimata Dall, Bull. M. C. Z., 18, p. 95, pl. 36, f. 9, 1889; Bull. 37, U. S. N. M., p. 98, pl. 36, f. 9, '89.

Distribution.—Hatteras and Gulf of Mexico, Lat. 24° N., Lon. 84° W. at 1920 fms., and between Mississippi and Cedar Keys at 1181 fms.

moseri Dall, Bull. M. C. Z., 18, p. 97, pl. 36, f. 3, 1889; Bull. 37, U. S. N. M., p. 98, pl. 36, f. 3, '89.

Distribution.—Cape Hatteras and Sarasota Bay, West Fla.

Genus **PLEUROTOMELLA** Verrill

packardi Verrill, Am. Jour. Sci., (3) 5, p. 15, 1873; Tr. Conn., Acad., 5, p. 453, pl. 43, f. 9, pl. 57, f. 5, '82.

Distribution.—Gulf of Maine to Rhode Island. The variety *benedicti* V. & S., (Dall, Bull. 37, U. S. N. M., p. 102, pl. 14, f. 4, pl. 60, f. 70 a, '89) ranges from Gulf of Maine to Bequia, 1290-1507 fms. Gulf of Mexico, West Florida region.

leucomata Dall, Bull. M. C Z., 9, p. 63, 1881, (as *Drillia*); 18, p. 120, pl. 11, f. 13, '89; Bull. 37, p. 102, pl. 11, f. 13, 1889.

Distribution.—Gulf of Mexico between Mississippi delta and Cedar Keys. Also Florida Strait. 533-940 fms.

agassizi Verrill and Smith, Am. Jour. Sci., 22, p. p. 394, 1880; Tr. Conn. Acad., 5, p. 454, pl. 57, f. 3, 3 a, '82.

Distribution.—Rhode Island to Cape Fear, N. C. The variety *mexicana* Dall (Bull. 37, U. S. N. M., p. 104, pl. 11, f. 14, 1889) ranges from Western Florida and Yucatan regions of the Gulf to Martinique. 502-640 fms.

filifera Dall, Bull. M. C. Z., 9, p. 56, 1881, (as *Bela*); 18, p. 123, pl. 12, f. 9, '89; Bull. 37, p. 104, p. 12, f. 9, '89.

Distribution.—Gulf of Mexico, West of Florida, 331 fms.

hadria Dall, Bull. M. C. Z., 18, p. 125, 1889; Bull. 37, p. 104, 1889.

Distribution.—Cape Fear, N. C., 407 fms. Also Gulf of Mexico between Mississippi delta and Cedar Keys, at 1181 fms.

extensa Dall, Bull. M. C. Z., 9, p. 55, Aug., 1881, (as var. of *Pleurotoma blakeana*); 18, p. 126, pl. 10, f. 2, '89; Bull. 37, p. 104, pl. 10, f. 2, '89.

Pleurotoma streptophora Watson, Jour. Linn. Soc., 15, p. 464, Nov. 1881; Chall. Gastr., p. 366, pl. 19, f. 8 a-b, 1885.

Distribution.—Gulf of Mexico, Lat. 23° N., Lon. 88° W., 804 fms.; Yucatan Strait 640 fms. Also North Atlantic.

blakeana Dall, Bull, M. C. Z., 9, p. 54, 1881; 18, p. 126, pl. 10, f. 1, '89; Bull. 37, p. 104, pl. 10, f. 1, '89.

brevis Verrill, Tr. Conn. Acad., 6, p. 417, pl. 44, f. 8, '85.

Distribution.—Gulf of Maine to Santa Cruz, W. I., 100-1608 fms. Also Yucatan Strait, 640 fms.; Florida Strait, 339 fms.

Genus **GLYPHOSTOMA** Gabb

gabbi Dall, Bull. M. C. Z., 18, p. 108, pl. 13, f. 4, 5, 7, 8, 1889; Bull. 37, U. S. N. M., p. 100, pl. 13, f. 4, 5, 7, 8, '89.

Distribution.—Gulf of Mexico, Blake Station 36, 84 fms.; U. S.F.C.Sta. 2405, west Florida, 30-50 fms. Also off Barbados.

gratula Dall, Bull. M. C. Z., 9, p. 64, Aug., 1881, (as *Pleurotoma*); 18, p. 110, pl. 12, f. 16, '89; Bull. 37, p. 100, pl. 12, f. 10, '89.

incilis Watson, Jour. Linn. Soc., 15, p. 425, Oct., 1881; Rept. Chall. Gastr., p. 304, pl. 24, f. 5, '85.

Distribution.—Gulf of Mexico between Mississippi delta and Cedar Keys, 227 fms. Also East Florida and Antilles. Pliocene, Caloosahatchie beds.

Genus **MANGILIA** Risso

balteata Reeve, Conch., Icon., 3, pl., 8, f. 57, 1846; Tryon, Man. Conch., 6, p. 247, pl. 24, f. 11, '84; Dall, Bull. 37, U. S. N. M., p. 100, '89; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 388, 1901.

Distribution.—Hatteras to Barbados and West Florida. Pliocene to Recent.

astricta Reeve, Pr. Z. S. p. 46, '46; Tryon, Man., 6, p. 260, pl. 24, f. 26, '84; Dall, Bull. 37, U. S. N. M., p. 100, '89.

Distribution.—West Florida to Florida Keys.

biconica C. B. Adams, Conch. Contr., p. 65; Dall Bull. 37, p. 100, '89.

Distribution.— West Florida to Jamaica. Unfigured.

plicosa C. B. Adams, Contr. Conch., p. 54, '50, (as *Pleurotoma*); Dall, Bull. 37, U. S. N. M., p. 100, pl. 50, f. 14, '89: Singly, 4th Ann. Rept, Tex. Surv., p. 333, '92; Johnson, Occ. Pa. Bost. Soc., N. H., 7, p. 145, 1915.

Pleurotoma plicata C. B. Adams, Bost. Jour. N. H., 3, p. 318, pl. 3, f. 6, '40. Not of Lamarck.

plicatum Kurtz, 1860; *brunnea* Perkins, '69.

Clathurella jewetti Stearns, Pr. A. N. S. Phila., fcr 1873, p. 346; Dall, Pr. U. S. N. M., 6, p. 329, 1883.

Distribution.—Massachussetts to Florida Keys and Gulf coast at Cedar Keys, Fla.; Corpus Christi Bay, Texas, 0-5 fms. Pleistocene, North Creek, Fla.; Pliocene, Caloosahatchie beds, Fla.

rubella Kurtz and Stimpson, Pr. Bost, Soc. N. H., 4, p. 115, '51; Dall, Bull. 37, U. S. N.M., p. 100, '89; Tr. Wagner Inst. Sci., 3, p. 41, '90.

Distribution.—Cape Lookout, N. C., to Charlotte Harbor, West Fla. Pliocene, Caloosahatchie beds. Pleistocene, Knapp's No. 2 well, Terrebonne Parish, La., at 1800 feet.

stellata Stearns, Pr. Bost. Soc., N. H., 15, p. 22, '72; Dall, Pr. U. S, N. M., 6, p. 328, '83; Tryon, Man. 6, p. 246, pl. 34, f. 84, '84; Dall, Bull. 37, p. 100, '89; Tr. W. I. S., 3, p. 41, '90.

Distribution.—Cedar Keys and Tampa to Key West, Fla., Pliocene, Caloosahatchie beds.

atrostyla Dall, Bull. 37, U. S. N. M., p. 102, pl. 41, f. 4, 4a, 1889.

Distribution.—Hatteras to Barbados. Also West Florida, 14-333 fms.

limonitella Dall, Pr. U. S. N. M., 6, p. 329, pl. 10, f. 10, 1883; Bull. 37, p, 102, pl. 48, f. 2, '89.

Distribution.—Cedar Keys to Tampa, Fla., 0-5 fms. Pleistocene, Knapp's No. 3 well, Terrebonne Parish, La., at 1150-1200 feet. Perhaps this species is a dwarfed form of *atrostyla* Dall.

cerina Kurtz & Stimpson, Pr. Bost. Soc., 4, p. 115, 1851; (as *Pleurotoma*); Hilgard, Rept., Chief Engineers to Sec., War., p.

358, 1870; House of Rep., Ex. Doc. 1, pt. 2; p. 886, '78; Dall, Pr. U. S. N. M., 6, p. 328,'83; Tryon, Man., 6, p. 310, pl. 22, f. 43, '84; Dall, Bull. 37, U. S. N. M., p. 102, pl. 44, f. 16a, '89; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903; Johnson, Bost. Soc. N. H., Occ. Pa., 7, p. 146, 1915.

Distribution.—Massachusetts to Texas. Gulf coast: Cedar Keys, St. Joseph's Bay, Crooked Island, Florida; Galveston and Corpus Christi, Texas. Pleistocene, New Orleans well of 1856; Lake Borgne borings; Grand Chenier; Knapp's wells, Terrebonne Parish, No. 2 well at 1190-1439, No. 3 at 1500-1525 feet.

cerinella Dall, Bull. M. C. Z., 18, p. 113, 1889; Bull. 37, U. S. N. M., p. 102, '89.

Distribution.—Hatteras to West Florida and Galveston, 14-22 fms. Pleistocene, Knapp's No. 3 well, Terrebonne Parish, La., at 1500-1525 feet; North Creek, Fla.

quadrata Reeve, Pr. Zool. Soc., p. 114, 1845, (as *Clathurella*); Tryon, Man., 6, p. 278, pl, 18, f. 25, '84: Dall, Bull. 37, U. S. N. M., p, 102, '89.

Distribution.—Hatteras to Yucatan. Dall regards *diminuta* C. B. Adams (Conch. Contr., p. 63) as a variety ranging from Hatteras to Florida Keys and West Fla.

melanitica Dall, Bull. 37, U. S. N. M., p. 102, 1889.

Distribution.—Hatteras to Haiti and West Florida.

antonia Dall, Bull. M. C. Z., 9, p. 59, 1881; 18, p. 116, pl. 10, f. 4, pl. 11, f. 11, '89; Bull. 37, U. S. N. M.,p. 102, pl. 10, f. 4, pl. 11, f. 11, 1889.

Distribution.—Yucatan Strait, 640 fms. Also Guadeloupe.

peripla Dall, Bull. M. C. Z., 9, p. 68, Aug., 1881; (as *Drillia*); 18, p. 115, pl. 11, f. 17, '89; Bull. 37, p. 102, pl. 11, f. 17, 1889.

chyta Watson, Jour. Linn. Soc., 15, p. 466, Nov., 1881 (as *Defrancia*); Rept. Chall. Gastr., p. 358, pl. 18, f. 4, 1885.

Distribution.—Yucatan Strait, 640 fms.

elusiva Dall, Bull. M. C. Z., 9, p. p. 69, Aug., 1881, (as *Drillia*); 18, p. 115, pl. 12, f. 7, '89; Bull. 37, U. S. N. M., p. 102, pl. 12, f. 7, '89.

Distribution.—Yucatan Strait, 640 fms. Perhaps identical with *Defrancia perpauxilla* Watson.

bandella Dall, Bull. M. C. Z., 9, p. 59, 1881; Verrill, Tr. Conn. Acad., 6, p. 250, '84; Dall, Bull. M. C. Z., 18, p. 116, pl. 10, f. 3, '89; Bull. 37, U. S. N. M., p. 102, pl. 10, f. 3, pl. 60, f. 73, '89.

Pleurotomella diomedeæ Verrill and Smith, Tr. Conn. Acad., 6, p. 152, pl. 31, f. 5, 5a, 1884.

Distribution.—East coast United States and Gulf of Mexico, Blake Station 47, at 321 fms, Greatest depth 2100 fms.

comatotropis Dall, Bull. M. C. Z., 9, p. 58, 1881; Verrill, Tr. Conn. Acad., p. 452, '82; Dall, Bull. M. C. Z., 18, p. 116, pl. 11, f. 12, '89; Bull. 37, U. S. N. M., p. 102, pl. 11, f. 12, pl. 44, f. 8, pl. 61, f, 77, '89; Johnson, Occ. Pa. Bost. Soc., N. H., 7, p. 146, 1915.

tiara Watson, Jour. Linn. Soc., p. 440, 1881; Chall. Gastr., p. 347, pl. 21, f. 7, '85.

Taranis pulchella Verrill, '82 and '84.

Distribution.—Massachussetts to Barbados, 50-1075 fms. Also Yucatan Strait, 640 fms.

pelagia Dall, Bull. M. C. Z.. 9, p. 61, 1881; 18, p. 117, pl. 11, f. 9, '89; Bull. 37, U. S. N. M., p. 102, pl. 11, f. 9, '89.

Distribution.—Gulf of Mexico, Blake Station 44, in 539 fms., bottom temperature 39° F. Also Antillean.

exsculpta Watson, Jour. Linn. Soc., p. 247, 1882, (as *Drillia*); Chall. Gastr., p. 371, Pl. 24, f. 2, '85 (as *Clionella*); Dall, Bull. M. C. Z., 18, p. 117, pl. 15, f. 9,'89; Bull. 37, p. 102, pl. 15, f. 9, '89.

Distribution.—Yucatan Strait, 640 fms. Also Santa Cruz, W. I.

subsida Dall, Bull. M. C. Z., 9, p. 62, 1881; 18, p. 118, pl. 12, f. 3, '89; Bull. 37, U. S. N. M., p. 102, pl. 12, f. 3, '89.

Distribution.—Gulf of Mexico, West of Florida, 339 fms. Also Cuba.

ipara Dall, Bull. M. C. Z.. 9, p. 57, 1881; 18, p. 115, f. 14, 1889.

Distribution.—Yucatan Strait, 640 fms. Also Martinique, 502 fms,

Genus **CYTHARELLA** Monterosato

cymella Dall, Bull. M. C. Z., 18, pl. 12, f. 4, 1889, (as *Cythara*); Bull. 37, U. S. N. M,, p. 100, pl. 12, f. 4, '89.

Distribution.—Gulf of Mexico, 220 fms. Also Antillean.

galvestonensis Harris, Bull. Am. Pal., vol. 1, p. 100, 1895.

Distribution.—Upper Miocene, Galveston well, at 2236-2871 feet.

Genus **DAPHNELLA** Hinds

leucophlegma Dall, Bull. M. C. Z., 9, p. 70, 1881; 18, p. 102, pl. 9, f. 9, 1889.

Distribution.—Gulf of Mexico, Blake Station 2, in 805 fms.

(Eubela) limacina Dall, Bull. M. C. Z., 9, p. 55, Aug., 1881; Verrill, Tr. Conn. Acad., 5, p. 452, '82; 6, p. 265, '84; Dall, Bull. M. C. Z., 18, p. 106, pl. 9, f. 10, '89; Bull. 37, U. S. N. M., p. 100, pl. 9, f. 10, '89.

hormophora Watson, Jour. Linn. Soc., 15, p. 457, Nov. 1881; Chall. Gastr., p. 351, pl. 21, f. 9, '85.

Distribution.—Massachussetts to Pernambuco. Gulf of Mexico, Yucatan Strait, 640 fms. and Blake Station 2, west of Florida, at 895 fms.

Genus **CANCELLARIA** Lamarck

reticulata Linnæus, Syst. Nat., ed. XII, p. 1190, 1767, (as *Voluta*); Sowerby, Thesaurus, 2, p. 442, pl. 92, f. 17, 1848; Tryon, Man., 7, p. 69, pl. 2, f. 25, 26, '85; Dall, Bull. M. C. Z., 18, p. 129, '89; Vanatta, Pr. A. N. S., Phila., 55, p. 757, 1903.

Distribution.—Hatteras to Guadeloupe, 5-30 fms. Gulf coast: Crooked Isl., Charlotte Harbor and Sarasota Bay, West Fla.; Chandeleurs, La.; Galveston, Tex. Pleistocene, New Orleans Pumping Station No, 7.

Note.—The fossil species, *C. conradiana* Dall, (Tr. Wagner Inst., 3, p. 42, 1890), is closely allied to *C. reticulata*.

galvestonensis Harris, Bull. Am. Pal., vol. 1, p. 100, pl. 3, f. 11, 1895.

Distribution.—Upper Miocene, Galveston well at 2552-2600 feet.

(Norona) clavatula Sowerby, Pr. Zool. Soc,, p. 52, 1832; Conch. Ill., f. 12, '32; Tryon, Man., 7, p. 75, pl. 4, f. 61, '85; Harris, Bull. Am. Pal., vol. 1, p. 99, '95; Dall, Pr. U. S. N, M., 37, p. 209, 1910.

Distribution.—Recent, Panama to Paita, Peru. Upper Miocene, Galveston well at 2552-2600 feet, (Harris). Not in the recent Atlantic fauna.

(Trigonostoma) agassizi Dall, Bull. M. C Z., 18, p. 130, pl. 35, f. 4, 1889; Bull. 37, U. S. N. M., p. 104, pl. 35, f. 4, '89.

Distribution.—Cape Lookout, N. C., 18 fms. Gulf of Mexico between Mississippi delta and Cedar Keys, 25 fms.

(Trigonostoma) tenera Philippi, Zeitsch. fur. Mal., 5. p. 24, '48;

Dall, Bull. 37, U. S. N. M., p. 104, '89; Tr. W. I. S., 3, p. 43, 1890.

stimpsoni Calkins, Pr. Dav. A. S., 2, p. 250, pl. 8, f. 4, 5, 1878.

Distribution.—Gulf of Mexico, Yucatan region. Pliocene, Caloosahatchie beds, Fla.

Genus **ADMETE** Kroyer

microscopica Dall, Bull. M. C. Z., 18, p. 131, 1889, (as *Trigonostoma?*); Bull. 37, U. S. N. M., p. 106, '89; Pr. U. S. N. M., 24, p. 504, pl. 29, f. 4, 1902.

Distribution.—Campeche Bank, 200 fms. Also off Fernandina and Cuba.

Genus **OLIVA** Martyn

circinata Marrat, Sowerby's Thes. Conch., 4, *Oliva*, p. 21, pl. 17, f. 277, 1880; Johnson, Nautilus, 24, p. 123, Mar., 1911.

litterata Lamarck, Ann. du Mus., 16, p. 315, 1810; Not of Bolten, 1798. Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 886, '78; Dall, Bull. 37, U. S. N. M., p. 106, pl. 34, f. 8, 8a, '89; Singley, 4th Ann. Rept. Tex. G. S., p. 333, '92; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903.

carolinensis Conrad, Pr. A. N. S. Phila., 14, p, 563, '63.

Distribution.—Hatteras to the West Indies, 0-2 fms. Gulf coast: Franklin and Calhoun Counties, Fla., Chandeleurs, Point on Fer, Cameron, La.; Galveston, Corpus Christi, Matagorda, Tex. Pleistocene, New Orleans artesian well of 1856, Lake Borgne borings, Knapp's wells, Terrebonne Parish, No. 1 well at 2000-2450, No. 2 at 1780-1800, No. 3 at 1150-2029 feet. Pliocene, Caloosahatchie beds, Fla.

liodes Dall, Tr. Wagner Inst. Sci., 3, p. 1576, pl. 58, 1903.

Distribution.—Lower Miocene, Chipola marl, West Florida; Bascom No. 2 well, Mobile, Alabama, at 1241 feet, Chipola horizon.

Genus **OLIVELLA** Swainson

mutica Say, Jour. A. N. S. Phila., 2, p. 228, 1822; Hilgard, Rept. Chief Engineers to Sec. War, p. 358, '70, House of Rep., Ex. Doc. 1, pt 2, p. 886, '78; Dall, Pr. U. S. N. M., 6, p. 324, '83; Bull, 37, U. S. N. M., p. 106, pl. 34, f. 1, 2, '89; Tr. W. I. S., p. 45, '90; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903; Deussen, U. S. G. S. Water-Supply Paper, No. 335, p. 77, 1914.

Distribution.—North Carolina to Trinidad Isl. Gulf coast: Recent, Cedar Keys, St. Mark's and St. Joseph's Bay, Fla.; Galveston and Corpus Christi, Tex. Pleistocene, New Orleans artesian well of 1856, Lake Borgne borings; Knapp's wells, Terrebonne Parish, No. 1 at 1600-1700, No. 2 at 1050-1842, No. 3 at 1150-1839 feet; North Creek, Manatee and Labelle, Fla. Pliocene, Caloosahatchie beds, Fla., and New Orleans Gymnasium well at 1200 feet. Miocene, Gilbert well No. 10, Bateson, Tex. at 323 feet.

pusilla Marrat, Thes. Conch., t. 21, f. 356-358, '71; Tryon, Man. Conch., 5, p. 64, pl. 14, f. 45, 46, '83; Vanatta, Pr. A. N. S. Phila., 55, p. 757, '03.

Distribution.—Cited by Vanatta from St. Joseph's Bay and Crooked Isl., West Fla.

nivea Gmelin, Linn. Syst. Nat., ed. XIII, p. 3442, 1792; Reeve, Conch. Icon., f. 64 a, '50; Tryon, Man., 5, p. 67, pl. 15, f. 74, '83; Dall, Bull. 37, U. S. N. M., p. 106, '89; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 393, '01.

Distribution.—Sarasota, West Fla. to Haiti, 27-805 fms.

jaspidea Gmelin, Syst. Nat., ed. 13, p. 3442, 1792; Reeve, Conch. Icon., 6, p. 22, f. 58, 1850; Dall & Simpson, Bull, U, S. Fish Com., 1, p. 392, 1901.

Distribution.—Hatteras to Brazil and West Florida, 27-805 fms.

floralia Duclos, in Chenu, Ill. Conch., p. 6; Tryon, Man., 5, p.

68, pl. 16, f. 2, 3, 1883; Dall, Bull. 37, U. S. N. M., p. 106, '89.

Distribution.—Hatteras to Tortola and West Florida.

eutacta Dall, Tr. Wagner Inst. Sci., 3, p. 1576, pl. 58, f. 3, 1903.

Distribution.—Lower Miocene, Chipola marl, Fla, and Mobile Oil Co's No. 2 Bascom well near Mobile, Alabama, at 1241 feet, Chipola horizon.

galvestonensis Harris, Bull. Am. Pal., vol. 1, p. 100, pl. 3, f. 13, 1895.

Distribution.—Upper Miocene, Galveston well at 2410-2871 feet.

subtexana Harris, Bull. Am. Pal., vol. 1, p. 101, pl. 4, f. 1, 1895.

Distribution.—Upper Miocene, Galveston well at 2552-2871 feet

Genus **MARGINELLA** Lamarck

carnea Storer, Jour. Bost. Soc., N. H., 1, p. 465, pl. 9, f. 3, 4, 1837; Sowerby, Thes., f. 103; Tryon, Man., 5, p. 33, pl. 10, f. 86, 1883; Dall, Bull. 37, U. S. N. M., p. 106, '89.

Distribution.—Charlotte Harbor, West Fla., Florida Keys and Antilles.

storeria Couthouy, Jour. Bost. Soc. N. H., 1, p. 440, pl. 9, f. 1, 2, 1837; Dall, Bull. 37, U. S. N. M., p. 106, '89.

Distribution.—Gulf of Mexico, West Fla., to Colon.

cassis Dall, Bull. M. C. Z., 18, p. 137, pl. 35, f. 8, 1889; Bull. 37, p. 106, pl. 35, f. 8, '89.

Distribution.—Gulf of Mexico, Lat. 25° N., Lon. 84° W., at 101 fms. Also off Cuba.

apicinca Menke, Syn. Meth. Moll., p. 87, 1828; Tryon, Man., 5, p. 33, pl. 10, f. 89, '83; Dall, Bull. 37, U. S. N. M., p. 106, '89; Singley, 4th Ann. Rept. Tex., p. 333, '92; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903; Vaughan, 2nd Ann. Rept. Fla. Geol. Surv., p. 148, 1909.

conoidalis Reeve, Conch. Icon., 15, pl. 18, f. 87.

Distribution.—Hatteras to Jamaica, Gulf coast: West Fla. and Texas, Pleistocene, Manatee, Orient and Labelle, West Florida.

pellucida Pfeiffer, Wiegmann's Archiv; 1, p. 258, 1840; Tryon, Man., 5, p. 33, pl. 10, f. 91, '83; Dall, Bull. 37, U. S. N. M., p. 106, '89.

Distribution.—Sarasota, West Fla. and West Indies.

watsoni Dall, Bull. M. C. Z., 9, p, 71, 1881; 18, p. 137, pl. 19, f. 3, pl. 38, f. 2, '89; Bull. 37, U. S. N. M., p. 106, pl. 19, f. 3, pl. 38, f. 2, '89.

Distribution.—Yucatan Strait, 640 fms. Also off Havana, 220-805 fms.

virginiana Conrad, Am. Jour. Conch., 4, p. 67, pl. 5, f. 4, 1868, (as *Prunum*); Dall, Bull. 37, U. S. N. M., p. 106, '89; Tr. W. I. S., 3, p. 48, '90.

Distribution.—Recent, North Carolina to Yucatan, 10-294 fms. Pliocene, Caloosahatchie beds, Fla. Miocene, James River, Va.

denticulata Conrad, Jour. A. N. S. Phila., 6, p. 225, pl. 9, f. 21, 1830. (Not of Tate, '78); Dall, Bull. 37, U. S. N. M., p. 108, '89; Tr. W. I. S. 3, p. 51, pl. 5 f. 8, 1890.

Distribution.—Recent, Hatteras to Barbados. Also West Florida, 5-294 fms. Pliocene, Caloosahatchie beds, Upper Miocene, Maryland and Virginia.

opalina Stearns, Pr. Bost. Soc. N. H., 15, p. 21, 1872; Dall, Pr. U. S. N. M., 6, p. 324, '83; Bull. 37, p. 108, '89, (as *denticulata* var. *opalina*).

Distribution.—Hatteras to Barbados. Recent, Tampa (type locality) and Cedar Keys, 14 fms. Also Barbados, 100 fms.

aureocincta Stearns, Pr. Bost. Soc. N. H., 15, p. 22, 1872; Dall, Bull. 37, U. S. N. M., p. 108, '89; Tr. W. I. S., 3, p. 52, 1890.

Distribution.—Virginia to West Florida, 3-44 fms. Pliocene, Caloosahatchie beds.

minuta Pfeiffer, Wiegmann's Archiv. fur Naturg. 1, p. 259, 1840; Tryon, Man., 5, p. 43, pl. 12, f. 60, '83; Dall, Bull. 37, U. S. N. M., p. 108, '89.

Distribution.—Mediterranean, West Indies, East and West Florida, 5 -294 fms. Miocene to Recent. Also Pleistocene, southern Europe and of North Creek, West Fla.

minima Guilding, Sowerby, Thes. Conch., 1, p. 388, pl. 78, f. 220, 1846; Dall, Pr. U. S, N. M., 6, p. 324, '83; Tryon, Man., 5, p. 44, pl. 12, f. 62, '83; Dall, Bull. 37, U. S. N. M., p. 108, '89.

Distribution.—Cape Lookout, N. C., to Haiti. Also West Florida at Cedar Keys, 0-22 fms.

Note.—Tryon placed this species in synonymy of *minuta* Pfr. According to Moerch *minima* is a synonym of *lavalleana* d'Orbigny, (Moll. Cuba, 2, p. 101, pl. 20, f. 36-38, 1842).

succinea Conrad, Pr. A. N. S. Phila., 26, pl. 1, f. 17, 1846; Tryon, Man., 5, p. 34, pl. 10, f. 93, '83; Dall, Bull. 37, U. S. N. M., p. 108, pl. 19, f. 6, '89.

Distribution.—Fernandina, East Fla., to Sombrero, W. I. Gulf coast at Tampa, 70-1002 fms. Placed by Tryon in synonymy with *nitida* Hinds.

fusina Dall, Bull. M. C. Z., 9, p. 72, 1881: 18, p. 138, pl. 19, f. 4, '89; Bull. 37, p. 106, pl. 19, f. 4, '89.

Distribution.—Yucatan Strait, 640 fms. Also off Fernandina, Fla.

yucatecana Dall, Bull. M. C. Z., 9, p. 72, 1881; 18, p. 138, pl. 19, f. 5, '89; Bull. 37, U. S. N. M., p. 106, pl. 19, f. 5, 1889.

Distribution.—Yucatan Strait, 640 fms. Also Sand Key, Fla., 125 fms.

seminula Dall, Bull. M. C. Z., 9, p. 72, 1881; 18, p. 139, pl. 19, f. 2, '89; Bull. 37, U. S. N. M., p. 108, pl. 19, f. 2, '89.

Distribution.—Yucatan Strait, 640 fms. Also Antillean.

rostrata Redfield, Cat. Marg., Am. Jour. Conch., 6, p. 246, (note), 1870; Dall, Bull. M. C. Z., 18, p. 137, '89; Tr. W. I. S., 3, p. 50, 1890.

oblonga Sowerby, Thesaurus, pl. 76, f. 106, 108. ʇoN *oblonga* of Swainson.

Distribution.—Gulf of Mexico, Lat. 23° N., Lon. 89° W., in 84 fms. Pliocene, Caloosahatchie beds.

(Volvarina) avena Valenciennes, in Kiener, Coq. Viv. *Marginella*, p. 17, pl. 6, f. 24, 1841; Sowerby, Thes. Conch., 1, p. 391, pl. 76, f. 130, '49; Dall, Bull. 37, U. S. N. M., p. 108, '89; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 394, 1901; Vaughan, Publ. No. 133, Carn. Inst., p. 171, 1910.

Distribution.—Key West to Colon. Also Texas region, Gulf of Mexico. Pliocene to Recent. Pleistocene, Labella, West Fla.

(Volutella) ovuliformis d'Orbigny, Moll. Cuba. 2, p. 101, pl. 20, f. 33-35, 1845; Dall, Bull 37, U. S. N. M., p. 108, '89; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 395, 1901; Vaughan, 2nd Ann. Rept. Fla. G. S., p. 148, 1910.

Distribution.—Cape Fear, N. C., to Guadeloupe Isl. Also West Florida. Pleistocene, Manatee, West Fla.

(Volutella) hadria Dall, Bull. M. C. Z., 18, p. 142, 1889; Bull. 37, U. S. N. M., p. 108, '89.

lacrimula Dall, Pr. U. S. N. M., 6, p. 324, 1883. Not *lacrimula* Gould, Pr. Bost. Soc. N. H., 8, p. 281, 1862.

Distribution.—Cedar Keys, West Fla. Collected by Hemphill on mud flats. Also Charlotte Harbor, West Fla.

Genus **VOLUTA** Linnæus

virescens Solander, Dillw. Desc. Cat., 1, p. 562, Sowerby, Thes. 1, pl. 52, f. 78; Tryon, Man., 4, p. 84, pl. 24, f. 35, 1882; Dall, Bull. 37, U. S. N. M,, p. 108, '89.

Distribution.—Texas to Cartagena, Colombia.

Genus **SCAPHELLA** Swainson

junonia Hwass, Chemnitz, Conch. Cab. 11, p. 16, pl. 177, f. 1703, 1704, pub. 1795; Dall, Bull. M. C. Z., 18, p. 148, pl. 34, f. 5, c-e, '89; Bull. 37, U. S. N. M., p. 110, pl. 34, f. 5, c-e, 1889.

Distribution.—North Carolina to Nassau. Also Gulf of Mexico, Lat. 25° N., Lon. 82° W., at 26 fms.

Genus **AURINIA** H. and A. Adams

dubia Broderip, Zool. Jour., 3, p. 81, pl. 3, f. 1, 1828, (as *Voluta*); Reeve, Conch. Icon., *Voluta*, pl. 22, f. 59, 1849; Tryon, Man., 4, p. 90, pl. 27, f. 77, 81, 1882; Dohrn, Jahrb. Mal. Ges., 6, p. 150, pl. 4, f. 1-3, '79; Dall, Bull. M. C. Z., 18, p. 151, '89; Bull. 37, U. S. N. M, p. 110, '89;Pr. U.S. N. M., 24, p. 504, pl. 29, f. 11, 1902.

Fusus tesellatus Schubert & Wagner, Suppl. Bd. Mart. und Chemn., Conch. Cab., 1829; Kiener and Reeve; but not of Zekeli and Pictet, 1852.

mutabilis Tuomey & Holmes, 1856. Not of Conrad, 1841.

Distribution.—Hatteras to Cape Florida. Gulf of Mexico between Mississippi delta and Cedar Keys, at 111 fms.

robusta Dall, Bull. M. C. Z., 18, p. 153, pl. 35, f. 2, '89; Bull. 37, p. 110, pl. 35, f. 2, '89.

Distribution.—Gulf of Mexico, Lat. 28° N., Lon. 86° W., at 280 fms. Also off Cuba, 119 fms.

Genus **MITRA** Lamarck

gemmata Sowerby, Thes. Conch., sp. 334, 1874; Tryon, Man., 4, p. 183, pl. 58, f. 688, '82; Dall, Bull. 37, U. S. N. M., p. 110, '89; (as var. of *hanleyi* Dohrn): Dall & Simpson, Bull. U. S. Fish Com., 1, p. 396, 1901.

Distribution.—Charlotte Harbor, West Florida, to Jamaica.

straminea A. Adams, Pr. Zool. Soc., p. 132, 1851; Sowerby, Thes. Conch., f. 561; Tryon, Man., 4, p. 140, pl. 41, f. 188, 1882; Dall, Bull. 37, U. S, N. M., p. 110, '89.

Distribution.—Gulf of Mexico, west of Florida.

wandoensis Holmes, Post-Plioc. Fos. S. Car., p. 77, pl. 12, f. 10, 10a, 1860, (as *Volutomitra*); Dall. Bull. 37, U. S. N. M.,p. 110, '89; Tr. W. I. S., 3, p. 92, 1890.

Distribution.—Cape Hatteras to Florida Straits and West Florida, 14-80 fms. Very closely allied to and probably identical with *M. rushi* Dall, (Conch. Exch., 2. p. 9, 1887; Bull. M. C. Z., 18, p. 160, '89) from the Gulf of Mexico, 27 fms., U. S. Fish Com. Station 2372.

styria Dall, Bull. M. C Z., 18, p. 159, pl. 15, f. 6, 1889; Bull. 37, U. S. N. M., p. 110, pl. 15, f. 6, '89.

Distribution.—Gulf of Mexico, west of Florida, 119 fms. Also Antillean,

(Conomitra) blakeana Dall, Bull. M. C. Z., 18, p. 163, 1889; Bull. 37, U. S. N. M., p, 110, '89.

Distribution.—Recent, Yucatan Strait, 640 fms. Closely related to the fossil species, *staminea* Conrad and *fusoides* Lea.

Genus **MITROMORPHA** A. Adams

pygmaea Dall, Tr. Wagner Inst. Sci., 3, p. 95, pl. 10, f. 3, 1890.

Distribution.—Type from Caloosahatchie marl, Fla., Pliocene. Also Bascom No. 1 well, near Mobile, Alabama, at 1500-1556 feet. Miocene. Not in the Recent fauna.

Genus **FASCIOLARIA** Lamarck

gigantea Kiener. Icon. Coq. Viv., p. 5. pl. 10, 11, 1840; Tryon, Man., 3, p. 75, pl. 60, f. 14, '81; Dall, Bull. 37, U. S. N. M., p. 112, '89; Tr. W. I. S., 3, p. 104, '90; Singley, 4th Ann. Rept. Tex. G. S., p. 334, '92; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 397, 1901; Vaughan, 2d Ann. Rept. Fla. G. S., p. 149, 1909; Johnson, Nautilus, p. 44, Oct., 1919.

Distribution.—Hatteras to Brazil. 0-10 fms. Gulf coast; West Florida; Point au Fer. La.; Corpus Christi and Matagorda Isl., Tex. Pleistocene, New Orleans pumping Station No. 7, North Creek and Manatee, West Fla. Pliocene, Caloosahatchie River marl.

tulipa Linnæus, Syst. Nat. ed X, p. 754, 1758, (as *Murex*); Kiener, Coq. Viv., p. 2, pl. 1, 2, 1840; Tryon, Man., 3, p. 74, pl. 59, f. 1-4, '81; Dall, Tr. W. I. S., 3, p. 101, pl. 7, f. 11, '90; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903; Johnson, Nautilus, p. 46, Oct., 1919.

Distribution.—North Carolina to Colombia and Antilles. 0-10 fms. Gulf coast: Cedar Keys, St. Joseph's Bay and St. Marks, West Fla., Texas coast. Pleistocene, North Creek, Fla. Pliocene, Caloosahatchie beds.

distans Lamarck, An. s. Vert., 7, p. 119, 1822; Tuomey & Holmes, Pl. Fos. S. C., p. 151, pl. 30, f. 7, 1857; Hilgard, House of Rep., Ex. Doc. 1, pt. 2, p, 886, '78; Dall, Tr. W. I. S., 3, p. 102, pl. 7, f. 10, '90; Singley, 4th Ann. Rept. Geol. Surv. Tex., p. 334, '92; Mitchell, List. Tex. Sh., p. 16; Vaughan, Publ. No. 133, Carn. Inst., p. 171, 1910; Johnson, Nautilus, p. 47, Oct., 1919.

Distribution.—Hatteras to Yucatan 0-54 fms. Gulf coast: Cedar Keys, St, Marks, Fla.; Cameron and Chandeleurs, La.; Galveston, Matagorda, Corpus Christi, and Mustang Isl., Texas. Pleistocene, New Orleans well of 1856, and pumping station No. 7; Orient and Labelle, West Fla. The Pliocene shell of the Caloosahatchie beds is the related, but slenderer, *F. apicina* Dall.

(Mesorhytis) meekiana Dall, Bull. M. C. Z., 18, p. 172, pl. 36, f. 7, 1889; Bull. 37, U. S. N. M., p. 112, pl. 36, f. 7, '89.

Distribution.—Gulf of Mexico, Blake Stations 16 and 20, at 292 and 220 fms. Also off Cuba, 400 fms. The first living species of Mesorhytis known, the type being the Cretaceous species, *gracilentis* Meek.

Genus **FUSINUS** Rafinesque

timessus Dall, Bull. M. C. Z., 18, p. 166, 1889; (as *Fusus*); Bull. 37, U. S. N. M., p. 112, '89.

Distribution.—Gulf of Mexico, between Mississippi delta and Cedar Keys, 60 fms.; between Cedar Keys and Dry Tortugas, 27 fms. Also near Cuba.

eucosmius Dall, Bull. M. C. Z., 18, p. 167, pl. 35, f. 5, 1889; Bull. 37, p. 112, pl. 35, f. 5, '89.

Distribution.—Gulf of Mexico, west of Florida. Also Barbados, 27-111 fms.

couei Petit, Journ de Conch., 4, p. 249, pl. 8, f. 1, 1853; Dall, Bull. M. C. Z., 18, p. 167, '89.

Distribution.—Gulf of Mexico, between Tampa and Dry Tortugas, 26 fms.

alcimus Dall, Bull. M. C. Z., 18, p. 170, 1889.

Distribution.—Gulf of Mexico, 100 miles north of Yucatan, 95 fms.

amiantus Dall, Bull. M. C. Z., 18, p. 169, pl. 15, f. 11, 1889; Bull. 37, U. S. N. M., p. 112, pl. 15, f. 11, '89.

Distribution.—Gulf of Mexico, Blake station 2, at 805 fms.

aepynotus Dall, Bull. M. C. Z., 18, p. 169, 1889.

Distribution.—Gulf of Mexico, 84 fms. Also Antillean.

amphiurgus Dall, Bull. M. C. Z., 18, p. 171, 1889.

Distribution.—Gulf of Mexico, Blake station 45, at 101 fms.

Genus **LEUCOZONIA** Gray

cingulifera Lamarck, 7, p. 107, 1822, (as *Turbinella*); Reeve, Conch. Icon., 4, pl. 3, f. 17, 1847; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 398, 1901.

Distribution.—Sarasota, Fla., to Texas and Brazil. Also Antillean.

ocellata Gmelin, Syst. Nat., p. 3488, 1792, (as *Buccinum*);Reeve, Conch. Icon., 4, pl. 8, f. 38, 1847; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 398, 1901.

Distribution.—Cedar Keys, Fla., to Guadeloupe, W. I.

Genus **BUSYCON** Bolten

pyrum Dillwyn, Desc. Cat. Rec. Sh., 1, p. 485, 1817; Dall, Bull. 37, U. S. N. M., p. 112, '89; Tr. W. I. S., 3, p. 112, '90; Singley, 4th Ann. Rept. G. S. Tex., p. 334, '92; Vanatta, Pr. A. N. S. Phila. p. 757, 1903; Vaughan, Publ. 133, Carn, Inst., p. 171, 1910.

Distribution.—Hatteras to Gulf of Mexico. Upper Miocene to Recent. Gulf coast: Cedar Keys, Fort Barranca, St. Mark's, Fla.; Cameron, &c. La.; Galveston, Matagorda, Corpus Christi, &c., Texas. Pleistocene of Louisiana at Grand Chenier and New Orleans pumping station No. 7. A high spired variety is found in abundance at Cedar Keys, Point au Fer, Cameron and Galveston, and in the Pleistocene of Grand Chenier, La., North Creek, Labelle, Manatee and Orient, West Fla.

canaliculatum Linnæus, Syst. Nat., p. 753, 1758, (as *Murex*); Holmes, Post-Pl. Fos. S. C. p. 66, pl. 11, f. 3, 1859; Hilgard, House of Rep., Ex. Doc., 1, pt. 2, p, 886, '78; Dall, Bull. 37, U. S. N. M., p. 112, pl. 73, f. 1, '89; Clark, Pleistocene Md., p. 180,pls. 46, 47, 48, 1906; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 139, 1915.

Distribution.—Cape Cod to West Florida and Texas. Pliocene (Carolinas). Pleistocene, New Orleans well of 1856 (Hilgard).

perversum Linnæus, Syst. Nat., p. 1222, 1766, (as *Murex*); Tuomey & Holmes, Pl. Fos. S. C , p. 145, pl. 29, f. 3,1856; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 886, '78; Dall, Tr. W. I. S., 3, p. 116, '90; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903; Vaughan, Publ. 133, Carn. Inst., p. 171, 1910.

Distribution.—Hatteras to Cuba. Miocene (Carolinas) to Recent, 0-3 fms. Gulf coast: Cedar Keys, St. Marks, &c., Fla.; Point au Fer, Cameron, La.; Galveston and Corpus Christi, Tex. Exceedingly abundant in the Pleistocene of Grand Chenier, La., and found by Hilgard in the Lake Borgue borings; also of Manatee, Orient, and Labelle, West Fla.; Pliocene, Caloosahatchie beds, Fla.

carica Gmelin, Syst. Nat., p. 3545, 1792, (as *Murex*); Holmes, Post-Pl. Fos. S. C.,p. 65, pl. 11, f. 1, 1859; Dall, Bull. U. S, N. M., p. 112, pl. 74, f. 1, '89; Clark, Pleistocene, Md., p. 179, pls. 43-45, 1906; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 139, 1915.

Distribution.—Massachussetts to the Antilles. 0-10 fms. Gulf coast, West Florida and Galveston, Tex.

eliceans Montfort, Conch. Syst. 303; Dall, Bull. 37, U. S. N. M., p. 112, '89.

Distribution.—South Carolina to Campeche. 0-5 fms.

Genus **MELONGENA** Schumacher

corona Gmelin, Syst. Nat., p. 3552, 1768; Tryon, Man., 3, p. 108, pl. 41, f. 199-203, 1881; Dall, T.. W. I. S., 3, p. 121,'90;

Vanatta, Pr. A. N, S. Phila., 55, p. 757, 1903; Vaughan, 2d Ann. Rept. G. S. Fla., p. 148, 1909.

Distribution.—Florida Keys to Yucatan and the Antilles. Gulf coast: Cedar Keys, St. Marks, St. Joseph Bay, Fla.; La.; and Tex. Pleistocene, North Creek, Orient and Labelle, West Fla.

melongena Linnæus, Syst. Nat. ed XII., p. 1220; Tryon, Man., 3, p. 107, pl. 41, f. 197, 198, 1881; Dall, Bull. 37,U. S. N. M., p. 112, '89; Harris, Bull. Am. Pal., vol. 1, p. 101, '95.

Distribution.—Florida to Grenada. 0-50 fms. Gulf of Mexico, Texas region. Also Upper Miocene, Galveston well at 2448-2465 feet (Harris).

Genus **CANTHARUS** Bolten

tinctus Conrad, Pr. A. N. S. Phila., p. 25, pl. 1, f. 9, 1846, (as *Pollia*); Dall, Bull. 37, U. S. N. M., p. 116, '89 (as *Tritonidea*); Dall and Simpson, Bull. U. S. Fish Com., 1, p. 399, 1901.

Distribution.—Hatteras to Vera Cruz. Gulf coast: Cedar Keys, Fla., and Matagorda, Texas. Pleistocene, North Creek, West Fla.

cancellaria Conrad, Pr. A. N. S. Phila., p. 25, pl. 1, f. 12, 1846; Dall, Pr. U. S. N. M., 6, p. 327, '83: Singley, 4th Ann. Rept. Tex. G. S., p. 334, '92; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903; Vaughan, 2d Ann. Rept. Fla. G. S., p. 148, 1909.

Distribution.—Florida to Isthmus of Panama. Gulf coast: Cedar Keys, Fla.; Horn Isl., Miss.; Cameron, Point au Fer, Chandeleurs, La.; Galveston, Tex. Pleistocene, Grand Chenier and New Orleans pumping station No. 7, and of Orient, West Fla.

orbignyi Payraudeau, Cat. Moll. de Corse, p. 159, pl. 8, f. 4-6, 1826, (as *Buccinum*); Dall, Bull. 37, U. S. N. M., p. 116, '89; Dall and Simpson, Bull. U. S. Fish Com., 1. p. 400, 1901.

Distribution.—Florida to Yucatan. 22-25 fms. Also Mediterranean.

limbatus Philippi, Abbild, 1, 3, pl. 1, f. 9, Tryon, Man., 3, p. 156, pl. 73, f. 257, 1881; Dall, Bull. 37, U. S. N. M., p. 116, '89.

Distribution.—Gulf of Mexico to Cuba.

Genus **PHOS** Montfort

candei d'Orbigny, Moll. Cuba, 2, p. 129, pl. 21, f. 23-25, 1845, (as *Cancellaria*); Arango, Fauna Mal. Cub., p. 201, 1878; Dall, Bull. 37, p. 116, 1889; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 401, 1901.

Distribution.—Hatteras to Colon and the Antilles. Gulf of Mexico, between Mississippi delta and Cedar Keys, at 88 fms. Synonyms, *fide* Dall, are *antillarum* Petit, 1853 and *grateloupensis* Petit, 1853.

parvus C. B. Adams, Contr. Conch., p. 59, 1850, (as *Triton*) ; Dall, Bull. 37, U. S. N. M, p. 116, 1889.

intricatus Dall, Pr. U.S.N. M., 6, p. 325, pl. 10, f. 9, '83.

Distribution.—Charlotte Harbor, West Fla., and Texas. Also Antillean.

galvestonensis Harris, Bull. Am. Pal. vol. 1, p. 102, pl. 4, f. 4, 5, 1895.

Distribution.—Upper Miocene, Galveston well at 2158-2871 feet.

Genus **NASSARINA** Dall

columbellata Dall, Bull. M. C. Z., 18, p. 182, 1889.

Distribution.—Cape Catoche, Yucatan.

grayi Dall, Bull. M. C. Z., 18, p. 183, pl. 32, f. 12a, 1889; Bull. 37, U. S. N. M., p. 116, pl. 32, f. 12a, '89.

Distribution.—Arrowsmith Bank, Yucatan, 130 fms. Also Antillean.

bushi Dall, Bull. M. C. Z., 18, p. 182, pl. 15, f. 12, 1889.

Distribution.—Gulf of Mexico, Blake station 5, 152-229 fms. Also off Sand Key, Fla. and Barbados.

Genus **ALECTRION** Montfort

vibex Say, Jour. A. N. S. Phila., (1), 2, p. 231, 1822, (as *Nassa*); Am. Conch., pl. 57, f. 2; Dall, Bull. 37, U. S. N. M., p. 116, pl. 50, f, 8, 1889; Singley, 4th Ann. Rept. Tex. G. S., p. 335, 1892; Johnson, Occ. Pa. Bost. Soc. N. H.,7, p. 134, 1915.

fretensis Perkins, Pr. Bost. Soc., 13, p. 117, 1869.

Distribution.—Cape Cod to Colon. Gulf coast: Cedar Keys and St. Mark's, Fla., Point au Fer, La., Galveston, Corpus Christi, Tex. Pleistocene, New Orleans pumping station No. 7; Manatee, Orient and Labelle, West Fla. Pliocene, Caloosahatchie.

ambiguus Montagu, Test. Brit., pl. 9, f. 7, 1803, (as *Buccinum*); Dall, Bull. M. C. Z., 18, p. 184, '89; Not *ambigua* Dunker (West African), which is *incrassata* Strom.

alba Say, 1826; *candidissima* C. B. Adams, Krebs Cat., p. 32.

Distribution.—North Carolina to West Florida and Barbados. Yucatan Strait, 640 fms. Variety *antillarum* d'Orb., Caloosahatchie Pliocene.

acutus Say, Jour. A. N. S. Phila., 2. p. 234, 1822, (as *Nassa*); Holmes, Post-Pl. Fos. S. C., p. 72, pl. 12, f. 3, 1860, (as *Buccinum*); Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 886, '78; Dall, Bull.37, U. S. N. M., p. 116, '89; Harris, Bull. Am. Pal., vol. 1, p. 102, '95; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903; Deussen, Water Supply Pa. 335, p. 77, 1914.

Distribution.—Carolinas to Barbados. Gulf coast: Recent, St. Joseph's Bay and Crooked Isl., West Fla.;Point au Fer, Cameron, La.; Galveston and Corpus Christi, Tex. Pleistocene, Knapp's wells, Terrebonne Parish, No. 1 at 1600-2443 feet, No. 2, 1050-1842, No. 3, 58-1839 feet, New Orleans artesian well of 1856, Lake Borgne borings. Pliocene, New Orleans Gymnasium Club well at 1200 feet. Upper Miocene, Galveston well, 2871 feet. Miocene, Gilbert well No. 10, Bateson, Texas at 323 feet.

consensus Ravenel, Pr. A. N. S. Phila., p. 43, 1861; Dall, Bull. M. C. Z., 18, p. 185, '89.

Distribution.—North Carolina to Florida. 8-49 fms. Gulf coast 20 miles off Charlotte Harbor, W. Fla., at 13 fms.

hotessieri d'Orbigny, Moll. Cuba, 2, p. 142, 1845, Atlas, pl. 21, f. 40-42, (as *Nassa*); Dall, Bull. M. C. Z., 18, p. 185, 1889; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 403, 1901.

Distribution.—Gulf of Mexico, Blake station 36, at 84 fms. Also Hatteras and Sombrero, 30-85 fms.

galvestonensis Harris, Bull. Am. Pal., vol. 1, p. 101, pl. 4, f. 2, 1895.

Distribution.—Upper Miocene, Galveston well at 2410-2871 feet.

trigalvestus Harris, Bull. Am. Pal., vol. 1, p. 101, pl. 4, f. 3, 1895.

Distribution.—Upper Miocene, Galveston well at 2158-2871 feet.

obsoletus Say, Jour. A. N. S. Phila., (1) 2, p, 232, 1822, (as *Nassa*); Gould, Inv. Mass., pl. 15, f. 210; Dall, Bull. 37, U. S. N. M., p. 116, pl. 50, f. 9, 1889; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 135, 1915; Dall, Bull. 112, U. S. N. M., p. 103, 1921.

Distribution.—Nova Scotia to Tampa, West Fla. Also San Francisco Bay, (introduced with oysters from the Atlantic).

beaumontensis Aldrich, Bull. No. 1, Univ. Texas, July, 1901; Nautilus, p. 74 and figs., Nov. 1901, (as *Nassa*).

Distribution.—Pleistocene. Spindle Top Hill oil well, near Beaumont, Texas, at 390 feet.

Genus **STROMBINA** Moerch

gibberula var. **galvestonensis** Harris, Bull. Am. Pal,, vol. 1, p. 103, pl. 4, f. 6, 1895.

Distribution.—Upper Miocene, Galveston well at 2410-2871 feet.

Note—The typical form of *gibberula* Sowerby, (Pr. Zool, Soc., p. 115, 1832), is recent on the Pacific coast of Central America southward to Paiti, Peru.

Genus **ANACHIS** H. and A. Adams

avara Say, Jour. A. N. S. Phila., 2, p. 230, 1882, (as *Columbella*); Tuomey and Holmes, Pl. Fos. S. C. p. 139, pl. 28, f. 12, 1857; Dall, Bull. 37, U. S. N. M.,p. 116, pl. 50, f. 12, '89; Vanatta, Pr. A. N. S. Phila., 55, p. 757, 1903; Johnson, Occ. Pa. Bost. Soc. N. H., p. 132, 1915.

Distribution.—Recent and Pleistocene. Massachussetts to Florida Keys. Gulf coast: Crooked Isl., West Fla., and Texas. Pleistocene, Lake Borgne borings, La., and North Creek, West Fla.

avara var. **semiplicata** Stearns, Pr. A. N. S. Phila., p. 344, 1873, (as *Columbella*); Tryon, Man., 5, p. 159, pl. 55, f. 70, 71, '83; Dall, Bull. 37, U. S. N. M., p. 116, '89.

Distribution.—Cedar Keys and Charlotte Harbor, West Fla.; Louisiana; Corpus Christi, Texas.

avara var. **similis** Ravenel, Pr. A. N. S. Phila., p. 41, 1861, (as *Columbella*; Tryon, Man., 5, p. 159, pl. 55, f. 69, '83; Dall, Bull. 37, p. 116. '89.

Distribution.—Carolinas to West Florida, Galveston and Yucatan.

avara var. **translirata** Ravenel, Pr. A. N. S. Phila., p. 42, 1861; Tryon, Man., 5, p. 159, '83; Dall, Bull. 37, p. 116, '89.

Distribution.—New York to West Florida, Louisiana and Yucatan.

catenata Sowerby, Pr. Zool. Soc., p. 52, 1844; Conch. Icon., 11, pl. 21, f. 119, 1858; Tryon, Man., 5, p. 179, pl. 58, f. 51, '83; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 404, 1901.

Distribution.—Jamaica to Porto Rico. A shell closely resembling this species, and probably identical with it, is in our collection. As far as I know, this is the first time that *catenata* has been found on the Gulf coast.

obesa C. B. Adams, Pr. Bost. Soc. N. H., 2, p. 2, 1845, (as *Buccinum*); Tryon, Man., 5, p. 169, pl. 57, f. 7 and 20, '83; Dall, Bull. 37, p. 118, '89; Singley, 4th Ann. Rept. Tex. G. S. p. 335, '92; Harris, Bull. Am. Pal., vol. 1, p. 102,'95; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903.

ornata Ravenel, *cancellata* Gaskoin. *A. ostreicola* Melvell is a dark brown or black variety.

Distribution.—Hatteras to St. Thomas, W. I. and Vera Cruz. Pliocene to Recent. Gulf coast: St. Joseph's Bay, Crooked Isl., West Fla.; Point au Fer, Cameron and Chandeleurs, La.; Galveston and Corpus Christi, Texas. Pleistocene, Grand Chenier, Teche No. 1 well, Jennings, La., at 1158-1199 feet, Knapp's well, Terrebonne Parish, No. 1 at 1050-1800 feet, No. 3 at 1150-1440 feet, Galveston well at 440-446 feet. Pliocene, New Orleans Gymnasium Club well at 1200 feet.

amphisella Dall, Bull, M. C. Z., 9, p. 91, 1881; 18, p. 188, pl. 19, f. 10*c*, '89; Bull. 37, U. S. N. M., p. 118, pl. 19, f. 10*c*, '89.

Distribution.—Yucatan Strait 43—640 fms.

hotessieriana d'Orbigny, Moll. Cuba, 2, p. 138, pl. 21, f, 37-39; Tryon, Man., 5, p. 144, pl. 52, f. 82, 1883; Dall, Bull. 37, p. 118, '89.

Distribution.—Tampa, West Fla., to Guadeloupe, W. I. Very closely allied to the following species.

pretri Duclos, Chenu, Conch. Ill., pl, 16, f. 7, 8; Tryon, Man., 5, p. 144, pl. 52, f. 76, 1883.

Note.—C. B. Adams' *albella* [Conch. Contr., p. 63, 1850, (as *Pleurotoma*); Dall Bull. U. S. N. M., p. 118, 1889] an unfigured species, is *fide* Dall and Simpson (1901) merely a mutation of *pretri*, as shown by cotypes from Adams.

Distribution.—Variety *albella*, Cape Fear, N. C., to West Florida and Jamaica.

Genus **COLUMBELLA** Lamarck

mercatoria Linnæus, Syst. Nat. ed. X, p. 730, 1758, (as *Voluta*); Kiener, Coq. Viv., *Columbella*, p. 23, pl. 5, f. 1, 1841; Dall, Bull. 37. p. 116, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 403, 1901.

Distribution.—Cape Lookout, N. C., to Barbados and West Florida. Pleistocene of Costa Rica.

rusticoides Heilprin, Tr. Wagner Inst. Sci., 1, p. 81, pl. 8, f. 9, 1887; Pr. A. N. S. Phila., p. 52, pl. 3, f. 2, '87; Dall, Tr. W. I. S., 3, p. 135, '90; Vaughan, Publ. No. 133, Carn. Inst., p. 171, 1910.

Distribution.—Cedar Keys and St. Marks, West Florida to Cuba. Pleistocene, Labelle, West Fla. Pliocene, Caloosahatchie beds, West Fla.

Genus **ASTYRIS** H. and A. Adams

lunata Say, Jour. A. N. S. Phila., 5. p. 213, 1826, (as *Nassa*) Tuomey and Holmes, Pl. Fos. S. C. p. 136, pl. 28, f. 6, 1857, (as *Buccinum*); Hilgard, House of Rep. Ex. Doc., 1, pt. 2, p. 886, 1878; Dall, Bull. 37, U. S. N. M., p. 118, pl. 50, f. 16, '89: Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 133, 1915.

Bnccinum zonalis Linsley, Am. Jour. Sci., (1); 48, p. 285, 1845.

Distribution.—Canada to Florida Keys. 0-12 fms. Gulf coast: Cedar Keys, Fla.; Chandeleurs, La.; Galveston and Corpus Christi, Tex. Pleistocene. Lake Borgne borings, La., Knapp's wells, Terrebonne Parish, No. 2 at 1050-1790, No. 3 at 258-1375 feet. Also of North Creek, Manatee and Labelle, West Fla. Pliocene of the Caloosahatchie, Fla.

duclosiana d'Orbigny, Moll. Cuba, 2 p. 136, pl. 21, f. 31-33, '45. (Not of Sowerby, 1847, which is a Javan shell); Dall, Bull 37, U.S.N.M.,p. 118, '89, (as *lunata* var.); Dall and Simpson, Bull. U. S. Fish Com., 1, p. 405, 1901.

Distribution.—Hatteras to Barbados and Tampa, West Fla. 0-63 fms.

diaphana Verrill, Tr. Conn. Acad., 5, p. 513, pl. 58, f. 2, 1882; Dall, Bull. M. C. Z., 18, p. 191, pl. 35, f. 9, '89; Bull. 37, U. S. N. M., p. 118, pl. 35, f. 9, '89.

Distribution.—Rhode Isl. to Gulf of Mexico between Mississippi delta and Cedar Keys, 64-487 fms.

Genus **NITIDELLA** Swainson

parvula Dunker, Zeitschr, Mal., p, 64, 1847, (as *Buccinum*); Tryon, Man., 5, p. 122, pl. 48, f. 77, '83; Dall, Bull. 37, U. S. N. M., p. 118, '89.

Distribution.—Gulf of Mexico, Texas region, to Barbados.

Genus **AESOPUS** Gould

stearnsi Tryon, Man. Conch., 5. p. 179, 1883, (as *Seminella*); Dall, Bull. M. C. Z., 18, p. 194, pl. 29, f. 5, '89; Bull. 37, p. 118, pl. 29, f. 5, '89.

filosa Stearns, Pr. A. N. S. Phila., p. 345 & fig., 1873, (as *Nitidella*). Not *Aesopus filosus* Angas, 1867, cf. *Columbella peculiaris* Guppy, Geol. Mag., London, pl. 18, f. 20, 1874.

Distribution.—Type locality, Tampa Bay, Fla. Also off Cape Fear, N. C. 15-17 fms. Pliocene of the Caloosahatchie, Fla.

Genus **MUREX** Linnæus

beaui Fischer and Bernardi, Jour. de Conch., 5, p. 295, pl. 8, f. 1, 1856; Dall, Bull. M. C. Z., 18, p. 195, '89; Bull. 37, U. S. N. M., p. 118, '89.

Distribution.—Gulf of Mexico between Mississippi delta and Cedar Keys, at 111 fms. Also Florida Reefs and Guadeloupe. 82-183 fms.

cabriti Bernardi, Jour. de Conch., 7, p. 301, pl. 10, f. 3, 1858; Dall, Bull. 37, U. S. N. M., p. 118, '89.

Distribution.—Hatteras to Barbados, Gulf of Mexico, Blake station 36, at 84 fms.

messorius Sowerby, Pr. Zool. Soc., p. 137, 1840; Conch. Illust., *Murex*, f. 93, 1839; Reeve, Conch. Icon., *Murex*, f. 90, '45; Dall, Tr. W. I. S., 3, p. 139, '90; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 407, 1901.

Distribution.—Gulf coast, Cedar Keys, Fla. and Texas, to Colon. 2-30 fms. Pleistocene, New Orleans pumping station No. 7. Pliocene of the Caloosahatchie River, Fla.

(Chicoreus) rufus Lamarck, Anim. s. Vert., ed. I, 7, p. 162,1882; Tryon, Man., 2, p. 90, pl. 15, f. 148, '80; (After Reeve, f. '19); Dall, Bull. 37, U. S. N. M, p. 118, '89.

sexcostata Emmons, Geol. N. Car., p. 248, f. 106, 1858.

Distribution.—Cape Fear, N. C., to Cartagena, Colombia, and Antilles. Also West Fla. 5-30 fms. Pliocene Caloosahatchie beds, Fla.

(Chicoreus) brevifrons Lamarck, Anim. s. Vert., ed. I, 7, p. 161, 1822; Reeve, Conch. Icon., 3, pl. 3, f. 13, 1845: Tryon, Man., 2, p. 95, f. 172, 1880; Dall, Bull. 37, U. S. N. M., p. 118, '89; Tr. W. I.S., 3, p, 140,'90; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 407, 1901.

Distribution.—South Carolina to Cartagena, Colombia. Gulf coast, West Fla. Pliocene, Caloosahatchie beds.

(Phyllonotus) pomum Gmelin, Syst. Nat., p. 3527, 1792; Reeve, Conch. Icon., 3, pl. 9, f. 35, 1845; Tryon, Man., 2, p. 97, pl. 20, f. 182, '80; Dall, Bull. 37, U. S. N. M., p. 120, pl. 16, f. 2, '89; Tr. W. I. S., 3, p. 142, '90; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 408, 1901.

oculatus Reeve, 1845; *asperrimus* d'Orbigny, 1853; *mexicanus* Petit, 1852; *imperialis* Swainson; *globosa* Emmons, 1858.

Distribution.—North Carolina to Venezuela. Gulf coast at various localities, West Fla.; Cameron and Chandeleurs, La., and Texas. Pleistocene, New Orleans pumping station No. 7. Pliocene, Caloosahatchie River, Fla. Lower Miocene, Antilles.

(Phyllonotus) fulvescens Sowerby, Conch. Illust., f. 30; Kobelt, Jahrb. Mal. Gesell., p. 155, '77; Dall, Bull. 37, U. S. N. M., p. 120, '89, Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903.

Distribution.—Hatteras and the Gulf coast at Indian Pass, West Fla.; Point au Fer, Chandeleurs, La.; Galveston, Corpus Christi and Quintana, Texas. Pleistocene, Grand Chenier, La., Knapp's wells, Terrebonne Parish, No. 1 at 2000-2150 feet, No. 3 at 790-830 feet.

Genus **FAVARTIA** Jousseaume

cellulosa Conrad, Pr. A. N. S. Phila., 3, p, 25, 1846, (as *Murex*); Dall, Bull. M. C. Z., 18, p. 210, pl. 16, f. 1, '89; (as *Ocinebra*); Bull. 37, U. S. N. M., p. 120, pl. 16, f. 1, '89; Tr. W. I. S., 3, p. 150. '90.

nuceus Moerch, Cat. Kierulf, p. 14, pl. 1, f. 9, '50; Cat. Yoldi, p. 95, 1852, (as *Ocinebra*).

Distribution.—Cape Lookout, N. C., to the Antilles and Vera Cruz. Gulf coast, Tampa Bay (type locality), Cedar Keys and Texas. Pliocene of the Caloosahatchie.

cellulosa var. **levicula** Dall, Bull. M. C. Z., 18, p, 211, 1889; Bull. 37, p. 120, '89, (as *Ocinebra*).

Distribution.—Cape Lookout, N. C., to West Florida and Yucatan. 22-37 fms.

intermedia C. B. Adams, Contr. Conch., p. 60, 1850, (as *Murex*); Dall, Bull, 37, U. S. N. M., p. 120, '89, (as *Ocinebra*);Dall, and Simpsou, Bull. U. S. Fish Com., 1, p, 408, 1901.

Distribution.—Key West to St Thomas and Texas region of the Gulf. Variety *alta* Dall, Caloosahatchie Pliocene.

Genus **UROSALPINX** Stimpson

cinereus Say, Jour. A. N. S. Phila., 2, p. 236, 1822, (as *Fusus*); Amer. Conch., 3, pl. 29, 1831; Gould, Inv. Mass., p. 370, f. 637, (as *Buccinum*); Tryon, Man., 2, p. 152, pl. 39, f. 3,'80; Dall, Pr. U. S. N. M., 6, p. 326, 1883; Bull. 37, U. S. N. M., p. 120, pl. 50, f. 6, '89; Johnson, Occ. Pa. Bost. Soc. N. H., p. 132, 1915; Dall, Bull. 112, U. S. N. M., p. 109, 1921.

Distribution.—Nova Scotia to Florida. Gulf coast, Cedar Keys (Dall); Pleistocene, Lake Borgne borings, La., (Hilgard). Also on the Californian coast (introduced with oysters).

perrugatus Conrad, Amer. Jour. Sci., p. 397, 1846, (as *Fusus*); Dall, Bull. M. C. Z., 18, p. 214, '89; Bull. 37, p. 120, '89; Vaughan, 2d Ann. Rept. Fla. G. S., p. 148. 1909.

Distribution.—West Florida from Cedar Keys to Key West. Type locality, Manatee River, West Fla. Pleistocene, North Creek and Orient, West Fla.

tampaensis Conrad, Pr. A.N.S. Phila., 3, p. 25, 1846, (as*Murex*); Dall, Bull. M. C. Z., 18, p. 214, '89; Bull. 37, U. S. N. M., p. 112, '89.

Distribution.—West Florida from Cedar Keys to Sarasota. Pleistocene, North Creek, West Fla.

Genus **MURICIDEA** Swainson

multangula Philippi, Zeitschr. fur Malak, 5, p. 25, 1849, (as *Fusus)*;Abbild. und Beschr , 3, p. 117, pl. 24, f. 6, 1850; Dall, Bull. 37, U. S, N. M., p. 120, pl. 76, f. 1, '89; Tr. W. I. S., 3, p. 149, 1890; Pr. U. S. N. M., 24, p. 505, pl. 30, f. 1, 1902.

hemphilli Dall, Pr. U. S. N. M., 6, p. 327, 1883.

Distribution.—Cape Fear, N. C., to Yucatan and the Northern Antilles, Gulf coast, Cedar Keys and Texas. 0-95 fms. Pliocene, Caloosahatchie beds.

ostrearum Conrad, Pr. A. N. S. Phila., 3, p. 25, 1846, (as*Murex*); Dall, Pr. U. S. N. M., 24, p. 505, pl. 30, f. 2, 1902.

floridana Conrad, Am. Jour. Conch., 5, p. 106, pl. 12, f. 4, 1869, (as *Urosalpinx*); Dall, Pr. U. S. N. M., 6, p. 326, '83; Bull. M. C. Z., 18, p. 212, '89; Tr. W. I. S., 3, p. 149, '90, Vaughan, 2d Ann. Rept. Fla. G. S., p. 148, 1909.

Distribution.—East Florida south of St. Augustine and Gulf of Mexico, Cedar Keys, Fla., to Yucatan. 0-13 fms. Rocky shores. Pleistocene, Manatee and Orient, West Fla. Pliocene, Caloosahatchie beds, Fla. Resembles *Urosalpinx perrugatus* Conrad, but is slenderer and has a very different operculum.

hexagona Lamarck, Anim. s. Vert., 7, p. 169, 1822, (as *Murex*); Reeve, Conch. Icon., 3, pl. 27, f. 120, 1845; Dall, Bull. 37, U. S. N. M., p. 120, '89; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 409, 1901.

Distribution.—Gulf of Mexico, Texas region to St. Thomas, W. I. 25 fms. Genotype.

philippiana Dall, Bull. M. C. Z., 18, p. 213, 1889; Bull. 37, U. S. N. M., p. 120, '89; Pr. U. S. N. M., 24, p. 504, pl. 29, f. 5, 1902.

Distribution.—Off Cape Catoche, Yucatan, and also Key West, Fla. 20-25 fms. Coral sand.

Genus **EUPLEURA** H. and A. Adams

caudata Say, Jour. A. N. S. Phila., 2, p. 236, 1822, (as *Ranella*); Stimpson, Am. Jour. Conch., 1, p. 58, pl. 8, f. 5, 1865; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 886, '78; Dall, Pr. U. S. N. M., 6, p. 326, '83; Bull. 37, U. S. N. M., p. 120, pl. 50, f. 11, '89; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 130, 1915.

Distribution.—Massachussetts to Florida. 1-3 fms. Gulf coast: Cedar Keys, St. Mark's, Charlotte Harbor, Fla.; Chandeleurs, La. Pleistocene, Lake Borgne borings and New Orleans well of 1856 (Hilgard), and of Labelle, West Fla.

caudata var. **sulcidentata** Dall, Tr. W. I. S., 3, p. 144, 1890.

Ranella clathrata "Gray" Calkins, Pr. Dav. Acad. Sci., p. 234, 1878.

muriciformis Tryon, Man., 2, p. 158, (in part). Not of Broderip.

Distribution.—Gulf coast of Florida, Pleistocene of Southwest Fla.

Genus **TROPHON** Montfort

(Boreotrophon) lacunellus Dall, Bull. M. C. Z., 18, p. 205, pl. 15, f. 4, 1889; Bull. 37, U. S. N. M., p. 120, pl. 15, f. 4, '89.

Distribution.—Cape Fear, N. C., to Dominica. Also West Florida. 227-769 fms.

Genus **THAIS** Bolten

patula Linnæus, Syst. Nat., ed. X, p. 739, 1758, (as *Buccinum*); Reeve, Conch. Icon., 3, pl. 1, f. 3, 1846; Tryon, Man., 2, p. 159, pl. 43, f. 19-22, '80; Dall, Bull. 37. U. S. N. M., p.

122, '89; (as *Purpura*); Dall, Pr. U. S. N. M., 37, p. 221, 1910.

Distribution.—East and West Florida to Texas, the Antilles and Brazil. Also Pacific, Gulf of California to Panama and Peru.

haemastoma Linnæus Syst. Nat., ed. XII, p. 1202; Reeve, Conch. Icon., 3, f. 21, 1846; Tryon, Man., 2, p. 167, pl. 49, f. 80, 83, 1880; Dall, Bull. 37, U. S. N. M., p. 122, pl. 34, f. 3, 4, pl. 46, 1a-2b, '89; Singley 4th Ann. Rept, Tex. G. S., p. 336, '92; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903. (All as *Purpura*).

Distribution.—Cape Hatteras to Trinidad Isl. Gulf coast Cedar Keys and Ft. Barranca, Fla.; Horn Isl., Miss.; Point au Fer, La.; Galveston, Corpus Christi, Tex. Pleistocene, Grand Chenier, La., New Orleans pumping station No. 7, Knapp's No. 3 well, Terrebonne Parish, at 1400-1440 feet.

haemastoma var. **floridana** Conrad, Jour. A. N. S. Phila., 7, p. 265, pl. 20, f. 21, 1837; Tryon, Man., 2, p. 167, pl. 49, f. 85, pl. 50, f. 86; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 411, 1901. (All as *Purpura*).

Distribution.—Florida to the Antilles, Gulf coast, West Fla., Cameron, Chandeleurs, La.; Matagorda Bay, Tex. Pleistocene of Grand Chenier, La., (very abundant and showing the same mutations as the living shells).

deltoidea Lamarck, Anim. s. Vert., 7, p. 247, 1822; Reeve, Conch. Icon., 3, pl. 4, f. 18, 1846; Kuster, Conch. Cab., pl. 32, f. 2; Tryon, Man., 2, p. 163, pl. 47, f. 55, 1880; Dall, Bull. 37, U. S. N. M., p. 122, '89; Dall and Simpson, Bull. U. S, Fish Com., 1, p. 411, 1901. (All as *Purpura*).

Distribution.—Florida to St. Vincent, W. I., Gulf coast, West Fla. and Tex.

Genus **SISTRUM** Montfort

nodulosum C. B. Adams, Pr. Bost. Soc. N. H., p. 2, 1845, (as *Purpura*); Tryon, Man., 2, p. 190, pl. 59, f. 275, 1880; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 411, 1901.

Distribution.—Cape Romano, southwest Florida, to Colon. Also Antillean.

roseum Reeve, Conch. Icon., sp. 46, 1846; Dall, Bull. 37, U. S. N. M., p. 122, 1889.

Distribution.—Gulf of Mexico, Texas region, to Barbados. The rosy color is thought to be caused by an encrusting hydrozoon.

Genus **CORALLIOPHILA** H. and A. Adams

abbreviata Lamarck, Enc. Me'th., pl. 435, f. 2a-b, 1795, (as *Pyrula*); Anim. s. Vert., 7. p. 146, 1822.

galea Chemnitz.

Distribution.—Cape Fear, N. C., to the Antilles. Gulf coast, West Florida. Pliocene, Caloosahatchie beds.

lactuca Dall, Bull. M. C. Z., 18, p. 220, pl. 16, f. 6, 1889.

Distribution.—Gulf of Mexico, Blake station 5, in 152-229 fms. Also off Fernandina, Fla.

deburghiae Reeve, Pr. Zool. Soc., p. 208, pl. 38, f. 3, 1857, (as *Rhizochilus*); Tryon, Man., 2, pl. 66, f. 383, 1880, (as *Latiaxis*); Dall, Bull. U. S. N. M., p. 122, pl. 16, f. 5, '89.

Distribution.—Cape Hatteras to Barbados. Also West Fla. 56-878 fms.

Genus **EPITOMIUM** Bolten

angulatum Say, Amer. Conch., No. 3, pl. 27, (two upper figs) 1831, (as *Scalaria clathrus* var.); Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, 1878; Dall. Bull. 37, U. S. N. M., p. 122, '89; Singley, 4th Ann. Rept. Tex. G. S., p. 336, '92; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 103, 1915.

Distribution.—Connecticut to West Fla., Point au Fer., La., and Galveston, Tex. Pleistocene, Lake Borgne, La., borings.

sayanum Dall, Bull. M. C. Z., 18, p. 313, 1889, (as *Scala*); Bull. 37, U. S. N. M., p. 122, pl. 50, f. 10, '89; Tr. W. I. S., 3, p. 158, '90; Singley, 4th Ann. Rept. Tex. G. S., p. 336, 1892.

clathrum Say (in part).

Distribution.—Virginia to Florida Keys, West Florida, Cameron, La., Corpus Christi and Galveston, Texas. Pleistocene, Grand Chenier, La. Pliocene, Caloosahatchie River, Florida.

tenue Sowerby, Pr. Zool. Soc., p. 110, 1844, (as *Scala*); Dall, Bull. 37, U. S. N. M., p. 122; 1889.

Distribution.—Gulf of Mexico, Texas and Cameron (?) La., to St. Thomas, W. I.

nitidellum Dall, Bull. M. C. Z., 18, p. 314, 1889, (as *Scala*); Bull. 37, U. S. N. M., p. 124, '89; Pr. U. S. N. M., 24, p. 505, pl. 30, f. 8, 1902.

Distribution.—Hatteras to Cedar Keys, Fla. 32-63 fms.

scipio Dall, Bull, M. C. Z., 18, p. 310, 1889; Bull. 37, U. S. N. M., p. 124, '89, (as *Scala*); Pr. U. S. N. M., 24, p. 506, pl. 29, f. 10, 1902.

Distribution.—Hatteras, N. C., to Texas and Vera Cruz, Mexico. 10-16 fms. Pink with white varices.

denticulatum Sowerby, Thes. Conch., p. 87, pl. 32, f. 25, 26, '47; Tryon, Man., 9, pl. 13, f. 100, 1887; Dall, Bull. 37, U. S. N. M., p, 124, '89.

Distribution.—Hatteras to West Florida and the Bahamas.

lineatum Say, Jour. A. N. S, Phila., 2, p. 242, 1822, (as *Scalaria*); Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, '78; Tryon, Man., 9, p. 79, pl. 16, f. 14, 87; Dall, Tr. W. I. S., 3, p. 158, '90; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 102, 1915.

Distribution.—Massachussetts to Charlotte Harbor and Cedar Keys, West Fla.; Cameron, Point au Fer, La.; Galveston and Corpus Christi, Tex. Pleistocene. Grand Chenier, La., and Knapp's No. 2 well Terrebonne Parish, at 1550-1570, 1731-1739 feet. Pliocene Caloosahatchie beds, Fla.

turriculum Sowerby, Thes. Conch., 1, p. 92, pl. 33, f. 61, pl. 34, f. 88, 1847; Singley, 4th Ann. Rept. Tex. G. S., p. 336, 1892.

Distribution.—Cape Hatteras to Haiti. 16-32 fms. Gulf coast at Galveston (Singley). Pliocene of the Caloosahatchie River, Fla.

mitchelli Dall, Nautilus, 9, p. 112, Feb. 1896; Pr. U. S. N. M., 24, p. 506, pl. 30, f. 3, 4, 1902.

Distribution.—Matagorda Island, Texas. Collected by J. D. Mitchell.

cochlea Sowerby, Thes. Conch., *Scalaria*, p. 103, pl. 35, f. 142 (only) 1847;Moerch, Jour. A. N. S. Phila., 8, p. 205, 1876; Tryon, Man.,9, p. 81, pl. 17, f. 24, 1887;Dall, Pr.U. S. N. M., 24, p. 506, pl. 30, f. 7, 1902.

Distribution.—Hatteras, N. C., to Tortola. W. I. Gulf of Mexico near Cedar Keys, Fla., at 25 fms. Sowerby's reference to its occurrence at Loando, Portuguese West Africa, is questionable.

galvestonense Harris, Bull. Am. Pal., vol. 1, p. 103, pl. 4, f. 7, 1895.

Distribution.—Upper Miocene, Galveston well at 2552-2871 feet.

Note.—The following species of *Epitomium* have been reported by Singley from the Texas coast:—*sericifila* Dall, (Bull. M. C. Z., 18, p. 313, 1889); *multistriatum* Say (Jour. A. N. S. Phila., 5, p. 208, 1826; Dall, Bull. 37, U. S. N. M., pl. 50, f. 5, 1889);*contorquatum* Dall, (Bull. M. C. Z., 18, p. 318, pl. 18, f. 9, 1889); and *modestum* C. B. Adams (Jamaica Shells). These species are not cited, as far as I am aware, by other authors from Gulf coast. They are not in our collections from the Gulf and are noted here solely *fide* Singley, (Fourth Ann. Rept. Tex. Geol. Surv., p. 336, 1892).

Genus **JANTHINA** Bolten

janthina Linnæus, Syst. Nat., ed. X., p. 772, 1758, (*Helix*); d'Orbigny, Voy. Am. Me'r., p. 413, pl. 61, f. 8-10, 1841; Dall, Pr. U. S. N. M., 37, p. 223, 1910; Johnson, Occ. Pa. Bost. Soc. N, H., 7, p. 101, 1915.

fragilis Lamarck, An. s. Vert., p. 89, 1801; Tryon, Man., 9, p. 36, pl. 9, f. 4, 1887; Singley, 4th Ann. Rept. G. S. Texas, p. 336, 1892; Bartsch, Bull. 91, U. S. N. M., p. 65, 1915.

Distribution.—Nantucket, Mass., to Colon; and West Fla. to Quintana and Galveston, Texas. Pelagic. Also Pacific Ocean, Lat. 42°N. to 36° S., and Indian Ocean, Port Alfred, S. E. Africa.

pallida Harvey, Thompson's Ann. Phil. and Nat. Hist., 5, p. 96, pl. 2, f. 2, 1841; Tryon, Man., 9, p. 37. pl. 10, f. 15, 1887.

Distribution.—Europe, the West Indies and Gulf of Mexico, Cameron, La. (washed ashore). Also tropical waters of the Pacific Ocean. Pelagic,

globosa Swainson, Zool. Illust. (1), 11, pl. 85, 1822; Tryon, Man., 9, pl. 10, f. 12, '87; Singley, 4th Ann. Rept. Tex., p. 336, '92; Mitchell, List Texas Shells; Bartsch, Bull. 91, U. S. N. M., p. 65, 1915.

Distribution.—Gulf Stream, Pelagic. Washed ashore at Quintana, Tex. and West Fla. Also Port Alfred, S.E. Africa.

communis Lamarck, An. s. Vert., ed, Desh., IX, p. 4; Tryon, Man., 9, pl. 9, f. 99, 1887; Dall, Bull. 37, U. S. N. M., p. 126, '89; Mitchell, List. Tex. Sh.; Bartsch, Bull. 91, U. S. N. M., p. 65. 1915.

Distribution.—Nantucket to Colon, West Florida, Matagorda Bay and Mustang Isl., Tex. Pelagic. Also Indian Ocean, Port Alfred, S. E. Africa.

Genus **MELANELLA** Bowdich

(Eulima) conoidea Kurtz and Stimpson, Pr. Bost. Soc., N. H., 4, p. 115, 1851; Dall, Pr. U. S. N. M., 6, p. 330, 1883; Tryon, Man., 8, p. 273, pl. 49, f. 40, '86; Dall, Tr. W. I. S., 3, p. 159, pl. 5, f. 11, 1890; Singley, 4th Ann. Rept. Tex., p. 336, '92; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 91, 1915.

Distribution.—Hatteras to the Autilles. Gulf coast: Cedar Keys, Fla.; Galveston and Corpus Christi, Tex. Pliocene, Caloosahatchie beds, Fla.

(Eulima) gracilis C. B. Adams, Contr. Conch., p. 110, 1850; Dall, Bull. 37, U. S. N. M., p. 126, '89.

Distribution.—Hatteras to St. Thomas, W. I., West Fla. and Yucatan. Pliocene, of the Caloosahatchie.

(Eulima) intermedia Cantraine, Diagn, Moll., Bull. Ac. Brux., p. 14, 1835; Tryon, Man., 8,.p. 274, pl. 69, f. 43, '86; Dall, Bull. 37, U. S. N. M., p. 126, pl. 52, f. 14,'89.

Distribution.—England to the Canary Isls., New England to West Florida and Barbados.

(Eulima) jamaicensis C. B. Adams, Pr. Bost. Soc., N. H., 2, p. 6, 1845; Tryon, Man., 8, p. 273, pl. 69, f. 41, '86; Dall, Bull. M. C. Z., 18, p. 327, 1889.

Distribution.—Gulf of Mexico, Blake station 20, in 220 fms. off West Fla. Also Barbados.

(Eulima) subcarinata d'Orbigny, Moll. Cuba, p. 217, pl. 16, f. 4-6; Tryon, Man., 8, p. 273, pl. 69 f. 44, 1886; Dall, Bull, 37, U. S. N. M., p, 126, '89.

Distribution.—West Florida to Haiti.

(Eulima) gibba De Folin, Les Me'le'agrines, p. 64, pl. 6, f. 4,'67; Tryon, Man., 8, p. 272, pl, 69, f. 35, '87; Dall, Bull. 37, U. S. N. M., p. 126, '89.

Distribution.—Cape Hatteras to Campeche.

(Liostraca) bilineata Alder, Moll. Northumberland and Durham; Tryon, Man., 8, p. 279, pl. 70, f. 72-74, 1887; Dall, Bull. 37, p, 126, '89.

Distribution.—Norway to Mediterranean, and West Florida to Haiti.

(Liostraca) hemphilli Dall, Pr. U. S. N. M., 6, p. 330, pl. 10, f. 4, 1883; Bull. 37, U. S. N. M., p. 126, pl. 48, f. 11, '89.

Distribution.—Cedar Keys to Marco, West Fla.

(Liostraca) fusus Dall, Bull.M. C. Z., 18, p. 329, pl. 19, f. 11b, '89; Bull. 37, U. S. N. M., p. 126, pl. 19, f. 11b, '89.

Distribution.—Fernandina, East Fla., to St. Kitts, W. I. Gulf of Mexico, Yucatan Strait, 640 fms. Also off Havana, 400 fms.

Genus **NISO** Risso

splendidula Sowerby, Pr. Zool. Soc., p. 6, 1834, (*Eulima*); A. Adams, Thes. Conch,, *Niso*, p. 801, No. 4, pl, 170, f. 8, '54; Tryon, Man., 8, p. 287, pl. 71, f. 24, '86; Dall, Bull. 37, U. S. N. M., p. 128, '89; Pr. U. S. N. M,, 37, p. 224, 1910.

Distribution.—Cape Fear, N. C. to Grenada, and Gulf of Mexico, between Mississippi delta and Cedar Keys in 111 fms. Also Pacific Ocean, Sta. Elena, Guayaquil Bay, Ecuador (Type locality), in 6-8 fms. (Cuming).

aeglees Bush, Rept. U. S. Fish Com., p. 83, 1883-'85; Dall, Bull. 37, U. S. N. M., p. 128, pl. 41, f. 10a, '89, (as *interrupta* Sowerby var.).

Distribution.—Hatteras to Tampa, West Fla., 7-32 fms. Pleistocene, Knapp's No. 3 well, Terrebonne Parish, La., at 1150-1200 feet.

Genus **PYRAMIDELLA** Lamarck

dolabrata Linnæus, Gmelin, Syst. Nat. p. 3585, No. 113, (as *Trochus*); Tryon, Man., 8, p. 300, pl. 72, f. 71-72; Dall, Bull. 37, U. S. N. M., p. 128, '89.

Distribution.—Sarasota, West Fla. to Barbados.

(Longchaeus) crenulata Holmes, Post-Pl. Fos. S. C., p. 88, pl. 13, f. 14, 14a, 1859, (as *Obeliscus*); Dall, Bull. M. C. Z., 18, p. 331, 1889; Tr. W. I. S., 3, p. 247, 1892; Vanatta, Pr. A. N. S. Phila., p. 758, 1903.

Obeliscus tesellatus Dall, Pr. U. S. N. M., 6, p. 330, 1883. Not of Adams, 1855. For full synonymy see Dall, 1889.

Distribution.—South Carolina to St. Thomas, W. I. Gulf coast, Cedar Keys, Tampa Bay. Fla., and Galveston,Texas. Pleistocene, North Creek, West Fla., and of the Lake Borgne borings, La. Habitat, grassy or muddy flats to 2 fms.

(Longchaeus) candida (Meuschen)Moerch,Mal. Blatt., 22, p. 158, (as *Obeliscus*); Dall, Bull. 37, U. S. N. M., p. 128, 1889; Tr. W. I. S., 3, p, 247, 1892.

Distribution.—Hatteras to Barbados and West Florida. Pleistocene of Texas.

(Syrnola) smithi Verrill, Pr. U. S. N. M., 3, p. 380, 1881,(as *Turbonilla*); Tr. Conn. Acad., 5, p. 538, pl. 58, f. 18, 1882; Bartsch, Pr. Bost. Soc. N. H., 34, p. 71, pl. 11, f. 11, 15, 1909; Johnson, Occ. Pa. Bost. Soc. N. H., 7, 92, '15. Not of Tryon.

Eulimella unifasciata Dall (pars), Bull. M. C. Z., 18, p. 338, pl. 19, f. 11c, 1889; Bull. 37, U. S. N. M., p. 130, pl. 19, f. 11c, '89. Not of Forbes (Rept. Aegean Inv., p. 188, 1843) which is a European shell.

Distribution.—Massachussetts to Barbados and West Fla.

(Syrnola) thelma Dall, Pr. U. S.N. M., 46, p. 254, pl. 20, f. 3, 1914.

Distribution.—Upper Miocene or Pliocene. Well near Alexandria, La., at 49 feet.

Genus **TURBONILLA** Risso

exilis C. B. Adams, Contr. to Conch., p. 74, 1850, (as *Chemnitzia*); Dall, Bull. 37, U. S. N. M., p. 128, '89; Tr. W. I. S., 3, p. 256, '92.

Distribution.—Hatteras to Haiti and West Florida, 3-63 fms. Pliocene of Caloosahatchie and Shell Creek, Fla.

belotheca Dall, Bull. M. C. Z., 18, p. 335, pl. 26, f. 7d, '89; Bull. 37, U. S. N. M., p. 128, pl. 26, f. 7d, '89.

Distribution.—Gulf of Mexico, Blake station 32, at 95 fms., west of Florida, 50 fms. Also Barbados, 100 fms.

interrupta Totten, Am. Jour. Sci., (1), 28, p. 352, f. 7, 1855, (as *Turritella*); Dall, Bull. 37, U. S. N. M., p. 128, pl. 26, f. 2, 2b, 1889; Tr. W. I. S., 3, p. 259, '92; Bartsch, Pr. Bost. Soc. N. H., 34, p. 87, pl. 12, f. 18, 23, 1909; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 95, 1915.

viridaria Dall, Pr. U. S. N. M., 6, p. 332, 1883.

Distribution.—Nova Scotia to Barbados. 2-107 fms. Gulf coast: Cedar Keys, Fla.; Galveston and Corpus Christi, Tex. Pleistocene, Lake Borgne borings, La., Knapp's wells, Terrebonne Parish, No. 2 at 1050-1790; No. 3 at 1150-1839 feet, also of North Creek, West Fla. Pliocene of the Caloosahatchie beds.

textilis Kurtz, Cat. Rec. Mar. Shells, N. and S. Car , p. 8, '60, (as *Chemnitzia*); Dall, Tr. W. I. S. 3, p. 257, 1892.

Distribution.—Charleston, S. C., to Marco, West Fla. Pliocene, Caloosahatchie beds.

obeliscus C. B. Adams, Contr. Conch., p. 72, 1850, (as *Chemnitzia*); Dall, Bull. 37, U. S. N. M., p. 128, '89; Tr. W. I. S., 3, p. 261, '92.

Distribution.—Hatteras to Jamaica. 12-63 fms. Gulf coast, West Fla. and Galveston, Tex. Pliocene, Caloosahatchie beds, Fla.

virga Dall, Pr. U. S. N. M., 6, p. 332, 1883; Bull. 37, U. S. N. M., p. 128, '89.

Distribution.—Hatteras to Florida Keys and Cedar Keys, Fla. 2-15 fms. Pliocene, Caloosahatchie River.

punicea Dall, Pr. U. S. N. M., 6, p. 332, 1883; Tr. W. I. S., 3, p. 261, 1892.

Distribution.—North Carolina to the Bahamas. 2-31 fms. Gulf coast, Cedar Keys, West Fla. Pliocene, Caloosahatchie beds.

curta Dall, Bull, M. C. Z., 18, p. 337, pl. 26, f. 7c, 1889; Bull. U. S. N. M., p. 128, pl. 26, f. 7c, '89.

Distribution.—Yucatan Strait, 640 fms. Also off Cape Hatteras and Antilles.

speira Ravenel, Pr. Elliott Soc. Nat. Hist, 1, p. 280, 1859, (as *Chemnitzia*);Holmes, Post-Pl. Fos. S. C., p. 82, pl. 13, f. 1, 1a, 1859; Dall, Tr. W. I. S., 3, p. 258, 1892.

Distribution.—Pleistocene, S. Carolina, and *fide* Hilgard, of the Lake Borgne, borings, La. Pliocene, Coloosahatchie beds (?). Not reported in the recent fauna.

reticulata C. B. Adams, Contr. Conch., p. 75, 1850; Dall, Tr. W. I. S., 3, p. 260, '92.

Distribution.—North Carolina to Jamaica, 0-60 fms. Reported by Singley from Galveston, Tex. Pliocene, Caloosahatchie beds, West Florida.

conradi Bush, Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903.

Distribution.—Cited by Vanatta from Calhoun Co., Northwest Florida.

(Parthenia) cedrosa Dall, Pr. U. S. N. M., 6, 1883; Bull. 37, U. S, N. M., p. 130, pl. 48, f. 4, 1889.

Distribution.—Cedar Keys, West Fla.

(Careliopsis?) styliformis Moerch, Malak,Blatt., 22, p. 169, 1874, Dall, Bull. M. C. Z., 18, p. 338, 1889; Bull. 37, U. S. N. M., p. 130, '89.

Distribution.—Hatteras to Sarasota Bay, West Fla. Also St. Thomas, W. I. 2-52 fms.

Genus **ODOSTOMIA** Fleming

acutidens Dall, Pr. U. S. Nat. Mus., 9, p. 331, 1883.

Distribution.—Hatteras to Cedar Keys, West Florida, 2-107 fms.

Note.—In 1892 (Tr. W. I. S., 3, p. 250), Dall regarded this shell as a variety of the European Miocene to Recent species, *O. conoidea* Brocchi (Conch. Foss. Subapp.,2, p. 659,pl. 16,f. 2, 1814). The latter species is recorded by Harris from the Pleistocene of the Galveston well at 440-458 feet.

impressa Say, Jour. A. N. S. Phila., 2,p. 244, 1822; Dall, Pr. U. S. N. M., 6, p. 331, 1883; Bull. 37, U. S. N. M., p. 130, pl. 52, f. 11, '89; Singley, 4th Ann. Rept. Tex. G. S., p. 337, '92; Bartsch, Pr. Bost. Soc. N. H., 34, pl. 13, f. 51, 1909; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 98, 1915.

Distribution.—Massachussetts to Florida. Gulf coast: Tampa and Cedar Keys, Fla., Corpus Christi, Tex. Pliocene, Caloosahatchie beds, Fla.

seminuda C. B. Adams, Jour. Bost. Soc. N. H., 2, p. 280, pl. 4, f. 13, 1839, (as *Jaminia*); Dall, Bull. 37, U. S. N. M., p. 130, pl. 52, f. 10, '89: Bartsch, Pr. Bost. Soc. N. H., 34, p.

97, pl. 13, f. 45, 48, 1909; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 97, 1915.

Distribution.—Massachussetts to Florida Keys and West Florida.

Genus **PERISTICHIA** Dall

toreta Dall, Bull. M. C. Z., 18, p. 340, 1889; Bull. 37, U. S. N. M., p. 130, pl. 42, f. 10,'89.

Distribution.—Cape Lookout, N. C., to Key West and Charlotte Harbor, West Fla. 2-22 fms.

agria Dall, Bull. M. C. Z., 18, p. 340, 1889; Bull. 37, U. S. N. M., p. 130, '89.

Distribution.—Marco, West Fla. 0-2 fms. Also Key West and off Hatteras.

Genus **ATLANTA** Lesueur

peroni Lesueur, Jour. de Physique, 85, p. 390, pl. 2, f. 1, 2, 1817; d'Orbigny, Voy. Ame'r, Me'rid.,p, 171, pl. 12, f. 1-15, 1836; Dall, Bull. 37, U. S. N. M., p. 136, pl. 43, f. 4, 4a, pl. 66, f. 110a, 1889; Pr. U. S. N. M., 37, p. 225, 1910; Bull. 112, U. S. N. M., p. 138, 1921.

Distribution.—West Atlantic, Lat. 42° N. to Tropics. Gulf of Mexico, West Fla. and Texas. Also eastern Pacific. Pelagic.

Genus **OXYGYRUS** Benson

keraudreni Lesueur, Jour. de Physique, 85, p. 391, pl. 2, 1817; H. and A. Adams, Genera Rec. Moll., 2, p. 92, 1858, 3, pl. 69, f. 6, 6b; Verrill, Trans. Conn. Acad., 6, p. 430, 1885; Dall, Bull. 37, U. S. N. M., p. 136, '89; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 130, 1915.

Distribution.—West Atlantic, Lat. 39° N. to Tropics. Gulf of Mexico, West Florida and Texas. Pelagic.

Genus **SIMNIA** Risso

(**Neosimnia**) **intermedia** Sowerby, Spec. Conch., No. 1, p. 9, f. 32, 33, (as *Ovulum*), Thes. Conch., *Ovulum*, No. 40, p. 479, pl. 100, f. 61, 62, 1848; Reeve, Conch. Icon., *Ovulum*, pl. 7, f. 33a. b, 1865; Tryon, Man., 7, p. 251, pl. 3, f. 85-86, (as *Ovnla*); Dall, Bull. M. C. Z., 18, p. 235, 1889; Bull. 37, U. S. N. M., p. 134, '89.

Distribution.—Hatteras to Brazil. Gulf coast, Vera Cruz. 15-170 fms.

(**Neosimnia**) **uniplicata** Sowerby, Thes. Conch., p. 478, pl. 100, f. 30-32, 1848, (as *Ovulum*); Reeve, Conch. Icon., *Ovulum*, pl. 9, f. 51a, b, 1865; Tryon, Man., 7, p. 254, pl 5, f. 39, 40, '85; Dall, Bull. 37, p. 134, '89; Bull. 112, U. S. N. M., p. 139, 1921.

Ovulum subrostratum Sowerby, 1848, *antillarum* and *arcuatum* Reeve, 1865. *carolinensis* Moerch, 1877.

Amphiperas canadiensis Moerch, 1882 (typ. err. for *carolinensis*).

Distribution.—Hatteras to Barbados and West Florida. 12-121 fms. Also Pacific coast, San Pedro, Cal. to Lower California.

Genus **CYPHOMA** Bolten

gibbosa Linnæus, Syst. Nat., ed. X, p. 726 1758, (as *Bulla*); Reeve, Conch. Icon., 15, pl. 7, f. 32, 1865, (as *Ovulum*); Tryon, Man., 7, p. 250, pl. 3, f, 81, 82, 1885; Dall, Bull. 37, U. S.N. M., p. 134, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 420, 1901, (as *Ultimus*).

Distribution.—Georgia to Trinidad, 15-50 fms. Also West Florida.

Genus **PEDICULARIA** Swainson

decussata Gould, Pr. Bost. Soc., N. H., 5, p. 127, 1855; Dall, Bull. M. C. Z., 18, p. 237, pl. 19, f. 9a-b, 1889; Bull. 37, U. S. N. M., p. 134, pl. 19, f. 9a-b, '89.

albida Dall, Bull, M. C. Z., 9, p. 39, 1881.

Distribution.—Georgia to Barbados, and Yucatan Strait, 640 fms.

Genus **CYPRAEA** Linnæus

spurca Linnæus, Syst, Nat., ed. X, p. 724, 1758; Reeve, Conch. Icon.. 3, pl. 14, f. 68, 1845; Tryon, Man., 7. p. 195, pl. 19, f. 16, 17, 1885; Dall, Bull. 37, U. S. N. M., p. 136, '89.

Distribution.—Cedar Keys, West Fla., to Barbados, 0-25 fms.

exanthema Linnæus Syst. Nat., ed. XII, p. 1172, 1767; Reeve, Conch. Icon., 3, pl. 5, f. 16, 1848; Tryon, Man., 7, p. 164, pl. 1, f. 4, 5, 1885; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 420, 1901.

Distribution.—Hatteras to Colon, West Florida and Texas. 0-10 fms.

cinerea Gmelin, Syst. Nat., p. 3404, 1792; Reeve, Conch. Icon., 3, pl. 22, f. 124, 1846; Tryon, Man., 7, p. 166, pl. 2, f. 15, 16, '85; Dall, Bull. 37, U. S. N. M., p. 136, '89.

Distribution.—Hatteras to Guadeloupe, West Florida and Texas. 0-163 fms.

Genus **TRIVIA** Gray

pediculus Linnæus, Syst. Nat., ed. X, p. 724, 1758, (as *Cypraea*); Reeve, Conch. Icon., 3, pl. 23, f, 131, 1846; Tryon, Man., 7, p. 201, pl. 21, f. 94, 95, 1885; Dall, Tr. W. I. S., 3, p. 168, '90.

Distribution.—St Augustine, Fla., to Barbados and West Fla. Pliocene, Caloosahatchie beds.

suffusa Gray, Descr. Cat. Cypr. p. 16, 1832; Tryon, Man., 7, p. 201, pl. 21, f. 1, 2, 1885; Dall, Bull. M. C. Z., 18, p. 240, 1889.

Distribution.—Cedar Keys, West Fla., to Barbados. 1-3 fms., on reefs. Pliocene, Caloosahatchie beds.

candidula Gaskoin, Pr. Zool. Soc., p. 200, 1835; Tryon, Man., 7, p. 203, pl. 22, f. 33, 34, '85; Dall, Bull. M. C. Z., 18, p. 240, '89; Bull. 37, U. S. N. M., p. 136, '89.

olorina Duclos, *approximans* Beck.

Distribution.—Hatteras to Barbados. 18-140 fms. Gulf of Mexico, Yucatan Strait, 640 fms.

globosa Gray, Descr. Cat. Cypr., p. 14, 1832; Tryon, Man., 7, p. 200, pl. 21, f. 92, 93, '85; Dall, Bull. M. C. Z., 18. p. 241, '89; Bull. 37, U. S. N. M., p. 136, '89.

pilula Kiener, *sphaerula* Mighels.

Distribution.—Gulf of Mexico, U. S. Fish Com. station 2373, west of Fla., at 23 fms. Also Key West and Antilles. Pliocene, Caloosahatchie beds.

Genus **ERATO** Risso

maugeriae Gray, In Sowerby, Conch. Illustr., p. 17, pl. 7, f. 47, 1832; Tryon, Man., 5, p. 9, pl. 4, f. 42, 43, '83; Dall, Tr. W. I. S., 3, p. 168, 1890.

laevis Emmons, N. Car. Geol. Rept., p. 262, f. 139, 1858. Not of Donovan.

Distribution.—Hatteras to Antilles and Colon; West Fla. and Vera Cruz. 0-63 fms,

Genus **BURSA** Bolten

affinis Broderip, Pr. Zool. Soc., p. 179, 1832, (as *Ranella*);

Tryon, Man,, 3, p. 42, pl. 22, f. 38, 1881; Dall, Bull, 37, U. S. N. M., p. 132, '89, (as *Gyrineum*).

Distribution.—Hatteras to the Antilles. Variety *cubaniana* d'Orbigny, dredged on Arrowsmith bank, Yucatan, also off Key West and Cuba.

Genus **DISTORTIO** Bolten

reticulatus Link, Beschr. Rostock Samml., 3, p. 122, 1807, (as *Distortrix*); Dall, Bull. 37, U. S. N. M., p. 132, '89; Dall and Simpson, Bull. U, S. Fish Com., 1, p. 416, 1901; Mitchell, List Tex. Shells, p. 11.

Distribution.—Hatteras to Barbados, West Florida and Mustang Island, Texas, 22-154 fms.

reticulatus var. **clathratus** Lamarck, An. s. Vert., 7, p. 186,1822,, Inc. Me'th., pl. 413. f. 4, (as *Triton*); Dall and Simpson, Bull. U. S. Fish Com., 1, p. 416, 1901.

Distribution.—Porto Rico and Gulf of Mexico near Key West (dredged by U. S. Fish Com.), also at Chandeleurs, La. Pleistocene, New Orleans pnmping station No. 7.

Genus **COLUBRARIA** Schumacher

lanceolata Menke, Synopsis, p. 87, 1828, (as *Ranella)*; Reeve, Conch. Icon., 2, pl. 18, f. 79, 1844, (as *Triton*); Kuster, Conch. Cab., pl. 65, f. 8; Tryon, Man., 3, p. 27, pl. 16, f. 162, 1881; Dall, Bull. 37, U. S. N. M., p. 132, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 416, 1901.

Distribution.—Hatteras to Barbados and Vera Cruz on the Gulf coast. Genotype

testacea Moerch, Yoldi Cat., 107, (as*Triton*); Mal. Blatt., 24, p. 25; Tryon, Man., 3, pl. 14, f. 128, 1881; Dall, Bull. 37, U. S. N. M., p. 132, '89; Tr. W. I. S., 3, p. 161, 1890.

Distribution.—Hatteras to Sombrero, and Texas region of the Gulf of Mexico. Pliocene, Caloosahatchie River, West Florida.

Genus **CYMATIUM** Bolten

olearium Linnæus, Syst. Nat., ed. XII, p. 1216, (*Triton*); Reeve, Conch. Icon., 2, f. 32, 1844: Tryon, Man., 3, p. 11, pl. 5, f. 27, '81; Dall, Bull. 37, U. S. N. M., p. 132, '89, (as *Lampusia*); Bartsch, Bull. U. S. N. M., p. 94, 1915.

Distribution.—Hatteras to Cartagena, Colombia, and the Texas region of the Gulf of Mexico. Also Indian Ocean, Port Alfred, South Africa.

chlorostomum Lamarck, An. sans Vert., 7, p. 185, 1822, (as *Triton*); Kiener, Icon. Coq. Viv., p, 19, pl. 12, f. 2; Tryon, Man., 3, p. 13, pl. 7, f. 47, 48, 1881; Dall, Bull. 37, U. S. N. M., p. 132, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 417, 1901,) as *Lampusia*).

Triton pulchellus C. B. Adams, Contr. Conch., p. 60, 1850.

Distribution.—East Florida to Barbados and Gulf of Mexico along the Mexican coast.

gracile Reeve, Conch. Icon., *Triton* f. 58, 1845; Tryon, Man., 3, pl. 12, f. 97, 1881; Dall, Bull. M. C. Z., 18, p. 227, pl. 29, f. 2, '89; Bull. 37. U. S, N. M., 132, pl. 29, f. 2, '89, (as *Lampusia*).

Distribution.—Cape Catoche, Yucatan, 24 fms., U. S. Fish Com. Also Colon and Barbados. Max. depth 100 fms.

cynocephalum Lamarck, An. sans Vert., 7, p. 184, 1822, (as *Triton*); Reeve, Conch, Icon., 2, pl. 8, f. 26, 1844; Tryon, Man., 3, p. 19, pl. 11, f. 80, pl. 15, f. 152, '81; Dall, Bull. 37, U. S N. M., p. 132, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 417, 1901, (as *Lampusia*).

Distribution.—Florida Straits to Margarita Isl. Texas region of the Gulf.

Genus **NYCTILOCHUS** Gistel

femorale Linnæus, Syst. Nat., ed. X, p. 749, 1758, (as *Murex*);

Reeve, Conch., Icon., 2, pl. 7, f. 22, 1844, (as *Triton*); Tryon, Man., 3, p. 18, pl. 10, f. 70, '81; Dall, Bull, 37, U. S. N. M., p. 132, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 417, 1901, (as *Lotorium*).

Distribution.—Cedar Keys, West Fla., to Guadeloupe.

Genus **ASPELLA** Moerch

scalarioides Blainville, Faune Francaise, p. 131, pl. 5, f. 5, 6, 1826, (as *Murex*); Dall and Simpson, Bull. U. S. Fish Com., 1, p. 410, 1910.

Distribution.—European and Antillean.

scalarioides var. **paupercula** C. B. Adams, Contr. Conch., p. 60, 1850, (as *Murex*); Dall, Bull. M. C. Z., 18, p. 208, '89; Bull. 37, U. S. N. M., p. 120, '89.

Triton cantrainei Recluz, Jour. de Conch., 4, pp, 246, 418, pl. 8, f. 10, 1853; Kobelt, Jahrb. Mal. Gesell., 4, p, 244, 1877, (as *Ocinebra*).

Distribution.—West Florida, at 50 fms.; Texas and the Antilles.

scalarioides var. **obeliscus** A. Adams, Pr. Zool. Soc., p. 269, 1851; Tryon, Man., 2, p. 129, pl. 38, f. 467, 1880; Dall, Bull. 37, U. S. N. M., p. 120, '89.

Distribution.—Vera Cruz to St. Thomas. Texas region of the Gulf.

Genus **OOCORYS** Fischer

abyssorum Verrill and Smith, Tr. Conn. Acad. Sci., 6, p. 177, (not the fig, which is *O. sulcata*), 1884, (as *Benthodolium*); Dall, Bull. M. C. Z., 18, p. 229, '89; Bull. 37, U. S. N. M., p. 132, '89.

Distribution.—Northern part of the Gulf of Mexico, U. S. Fish Com. station, No. 2400, in 169 fms. Also off Carolina. Max. depth 2221 fms.

Genus **CASSIS** Lamarck

cameo Stimpson, Silliman's Am. Jour. Sci., p. 443, 1860; Tryon, Man., 7, p. 271, pl. 2, f. 50, '85; Dall, Bull. 37, U. S. N. M., p. 134, '89.

Distribution.—Hatteras to Barbados and West Fla.

tuberosa Linnæus, Syst. Nat., ed. X, p. 735, 1758, (as *Buccinum*); Reeve, Conch. Icon., 5, pl. 3, f. 7, 1848; Tryon, Man. Conch., 7, p. 271, pl. 2, f. 51, '85; Dall, Bull. 37, U. S. N. M., p. 134, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 418, 1901.

Distribution.—Hatteras to Barbados and West Fla.

(Cypraecassis) testiculus Linnæus, Syst. Nat., ed. X, p. 736, 1758, (as *Buccinum*); Reeve, Conch. Icon., 5, pl. 4, f. 10, 1848; Tryon, Man., 7, p. 273, pl. 2, f. 64, pl. 4, f. 63, '85; Dall, Bull. 37, U. S. N. M., p. 134, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 418, 1901.

Distribution.—Hatteras to Trinidad, W. I., and the Texas region of the Gulf.

(Semicassis) inflata Shaw, Nat. Misc., 5, p. 22, pl. 959, 1812; Tryon, Man., 7, p. 274, pl. 4, f. 65, '85; Dall, Bull. 37, U. S. N. M., p. 134, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 418, 1901; Mitchell, List Tex. Shells, p. 6; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903.

Distribution.—Hatteras to Brazil, Gulf coast: Calhoun Co. West Fla.; Point au Fer, Chandeleurs, Lost Island, La.; Galveston, Tex. Pleistocene, New Orleans pumping station No. 7, Knapp's No. 2 well, Terrebonne Parish, at 1791-1842 feet.

Genus **ONISCIDIA** Swainson

dennisoni Reeve, Pr. Zool. Soc., p. 21, 1842, (as *Oniscia*); Tryon, Man., 7, p. 282, pl. 10, f. 20, '85; Dall, Bull. M. C. Z., 18, p. 231, '89.

Distribution.—Arrowsmith Bank, Yucatan, at 130 fms. Also Guadelonpe Island. (Type locality).

Genus **TONNA** Brunnich

galea Linnæus, Syst. Nat., ed. X, p. 734, 1758, (as *Buccinum*); Reeve, Conch. Icon., 5, pl. 1, 1848; Tryon, Man., 7, p. 261, pl. 1, f. 3, '85; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 419, 1901. (All as *Dolium*).

Distribution.—Hatteras to Trinidad, West Florida, Louisiana, Galveston and Matagorda, Texas. Also Mediterranean.

perdix Linnæus, Syst. Nat., ed. X, p. 734, 1758, (as*Bucciuum*); Reeve, Conch. Icon., 5. pl. 6, f. 9, 1849, (as *Dolium*); Tryon, Man., 7, p. 264, pl. 3, f. 15, pl. 4, f. 23-25, '85; Dall, Bull. 37, U. S. N. M., p. 134, '89.

Distribution.—West Florida to Brazil.

Genus **PYRULA** Lamarck

papyratia Say, Jour. A. N. S. Phila., 2, p. 238, 1822; Tryon, Man., 7, p. 266, pl. 6, f. 35, '85; Dall, Tr. W. I. S., 3, p. 163, '90; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903.

Distribution.—North Carolina to the West Indies. Gulf coast, Calhoun Co., Fla. and Texas. Pleistocene, New Orleans pumping station No. 7 and of Fla. Pliocene, Caloosahatchie River.

Genus **STROMBUS** Linnæus

pugilis Linnæus, Syst. Nat., ed. X, p. 744, 1758; Reeve, Conch. Icon., 6, pl. 16, f. 39-41, 1851; Tryon, Man., 7, p. 109, pl. 2, f. 13-15, '85; Dall, Tr. W. I. S., 3, p. 177, '90; Singley, 4th Ann. Rept. Tex., p. 338, '92; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 422, 1901; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903; Vaughan, Publ. No. 133, Carn. Inst., p. 171, 1910.

Distribution.—Hatteras to Colon. Gulf coast; Cedar Keys and Calhoun Co., West Fla.; Point au Fer, Chandeleurs, Cameron, La., Galveston and Corpus Christi, Tex. Pleistocene, Grand Chenier, La., New Orleans pumping station No. 7; North Creek, and Labella, West Fla. Pliocene, Caloosahatchie River.

costatus Gmelin, Syst. Nat., p. 3520, 1792; Tryon, Man., 7, p. 108, 1885; Dall, Bull. 37,U. S. N. M., p. 136, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 422, 1901.

accipitrinus Reeve, Conch. Icon., 6, pl 7, f. 12, 1850; Tryon, Man., 7, pl. 1, f. 7, '85.

Distribution.—St. Augustine, East Fla. to Guadeloupe, W. I. Also West Fla.

Genus **SEGUENZIA** Jeffreys

monocingulata Seguenza, Boll. Comitato Geologico, 7, p. 188,'76; Watson, Chall. Rept. Gastr., p. 105, '86; Dall, Bull. M. C. Z., 18, p. 268, '89; Bull. 37, U. S. N. M., p. 142, pl. 62, f. 88, 89, 1889.

formosa Jeffreys, Rept. Valorous Cruise, p. 200, 1876; Dall, Bull. M. C. Z., 9, p. 268, '89.

Distribution.—Western North Atlantic and Bay of Biscay. Gulf of Mexico, West Florida and Texas regions. 100-2033 fms.

trispinosa Watson, Jour. Linn. Soc., 14, p. 591; Chall. Rept. Gastr., 15, pl. 7, f. 4, 1886; Tryon, Man., 9, p. 47, pl. 8, f. 79, 80, 1887, Dall, Bull. 37, U. S. N. M., p. 142, 1889.

Distribution.—Hatteras to Pernambuco, Brazil and the Tex region of the Gulf. 294-675 fms.

iconica Watson, Jour. Linn. Soc., 14, p. 589, 1879; Chall. Rept. Gastr., 15, p. 107, pl. 7, f. 3, 1886; Tryon, Man., 9, p. 47, pl. 8, f. 77, 78, '87; Dall, Bull. M. C. Z., 18, p. 269, 1889.

Distribution.—Gulf of Mexico, Florida Strait region, Culebra Isl., W. I., and off the Azores. 390-1568 fms.

Genus **TRIPHORA** Blainville

perversa var. **nigrocincta** C. B. Adams, Jour. Bost. Soc. N. H., 2, p. 286, pl. 4, f. 11, 1839, (as *Cerithium*); Gould, Inv. Mass., p. 323, f. 592, 1870; Dall, Pr. U. S. N. M., 6, p. 333, '83; Bull. 37, U. S. N. M., p. 138, '89; Singley, 4th Ann. Rept. G. S. Tex., p. 338, '92; Dall, Tr. W. I. S., 3, p. 263,'92; Johnson. Occ. Pa. Bost. Soc. N. H., 7, p, 126, 1915.

Distribution.—Massachussetts to Barbados. 0-30 fms. Gulf coast: Cedar Keys, Florida, Corpus Christi, Texas. Pliocene, Caloosahatchie beds, West Fla.

decorata C. B. Adams, Contr. Conch., p. 177, 1850, (as *Cerithium*); Dall, Tr. W. I. S., 3, p. 265, 1892.

Distribution.—Gulf of Mexico, north and east shores, and the Antilles. Also Lower Miocene of the Chipola marl, West Florida. Variety *olivacea* Dall, (Bull. M. C. Z., 18, p. 244, 1889; Bull. 37, U. S. N. M., p. 138, '89), Gulf of Mexico, west of Florida, in 50 fms. Also Key West and Antilles.

colon Dall, Bull. M. C. Z., 9, p. 86, 1881; 18, p. 247, pl. 20, f. 12, '89; Bull. 37, U. S. N. M., p. 138, pl. 20, f. 12, '89.

Distribution.—Yucatan Strait, 640-1002 fms. Also off Havana, Cuba, 450 fms.

triserialis Dall, Bull. M. C. Z., 9, p. 84, 1881; 18, p. 246, pl. 20,

f. 5a, 6a, 1889; Bull. 37, U. S. N. M., p. 138, pl. 20, f. 5a, 6a, 1898.

Distribution.—Yucatan Strait, 640 fms. Also off Barbados, 154 fms.

bigemma Watson, Jour. Linn. Soc., 15, p. 101, 1880; Dall, Bull. M. C. Z., 9, p. 81, 1881; Watson, Chall. Rept. Gastr., p. 562, pl. 43, f. 6, '85; Dall, Bull. M. C. Z., 18, p. 248, '89.

Distribution.—Yucatan Strait, 640 fms. Also off St. Thomas, W. I., 390 fms.

hircus Dall, Bull. M. C. Z., 9, p. 83, 1881; 18, p. 249, pl. 20, f. 11, '89; Bull. 37, U. S. N. M., p. 138, pl. 20, f. 11, '89.

Distribution.—Yucatan Strait, 640 fms. Perhaps a variety of *bigemma* Watson.

abrupta Dall, Bull. M. C. Z., 9, p. 84, 1881; 18, p. 249, pl. 20, f. 9, '89; Bull. 37, U. S. N. M., p. 138, pl. 20, f. 9, '89.

Distribution.—Yucatan Strait, Cape San Antonio, 640 fms.

torticula Dall, Bull. M. C. Z., 9, p. 82, 1881; 18, p. 249, pl. 20, f. 11b, '89; Bull. 37, U. S. N. M., p. 138, pl. 20, f. 11b, 1889.

Distribution.—Yucatan Strait, 640 fms.

inflata Watson, Jour. Linn. Soc,, 15, p. 101, 1880; Dall, Bull. M. C. Z., 9, p. 81, 1881; Watson, Chall. Rept. Gastr., p. 564, pl. 40, f. 1, '85; Dall, Bull. M. C. Z., 18, p. 249, 1889.

Distribution.—Yucatan Strait, 640 fms. Also off Georgia, St. Augustine and Culebra Isl. 294-640 fms.

inflata var. **ibex** Dall, Bull. M. C. Z., 9, p. 86, 1881; 18, p. 249, pl. 20, f. 12b, '89.

Distribution.—Yucatan Strait, off Cape San Antonio, in 640 fms. Also off Havana, 450 fms.

cylindrella Dall, Bull. M. C. Z., 9, p. 83, 1881; 18, p. 250, pl. 20, f. 6, '89; Bull. 37, U. S. N. M., p. 138, pl. 20, f. 6. '89.

Distribution.—Cape San Antonio, Yucatan Strait, 640 fms.

Genus **CERITHIOPSIS** Forbes and Hanley

greenei C. B. Adams, Jour. Bost. Soc. N. H., 2, p. 287, pl. 4, f. 12, 1839, (as *Cerithium*); Dall, Bull. 37, U. S. N. M., p. 138, pl. 52, f. 2, '89; Tr. W. I. S., 3, p. 269, '92; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 126, 1915.

Distribution.—Prince Edward Island to Dominican Republic and west of Cedar Keys, Fla., Corpus Christi and San Antonio, Texas. 3-10 fms. Pliocene, Caloosahatchie River, Florida.

crystallina Dall, Bull, M. C. Z., 9, p, 89, 1881; 18, p. 254, pl. 20, f. 3, '89; Bull. 37, U. S. N. M., p. 138, pl. 20, f. 20, f. 3, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 424, 1901.

Distribution.—Washed ashore dead, Cedar Keys, Florida, dredged alive west of Florida in 50 fms. Common in Antillean dredgings. 50-805 fms.

martensi Dall, Bull. M. C. Z., 18, p. 255, pl. 20, f. 2, '89; Bull. 37, U. S. N. M,, p. 138, pl. 20, f. 2, '89.

Distribution.—Gulf of Mexico, west of Florida, at 1181 fms.

vanhyningi Bartsch, Pr. Biol. Soc. Washington, 31, p. 135, 1918.

Distribution.—Tampa Bay, West Fla.

burkevillensis Dall, Pr. U. S. N. M., 46, p. 231, pl. 22, f. 5, 1914.

Distribution.—Upper Miocene or Lower Pliocene, Burkeville, Texas.

(**Eumeta**) **subulata** Montagu, Test. Brit. Suppl., p. 115, pl. 30, f. 6, 1808, (as *Murex*); Dall, Bull. M. C. Z., 18, p. 252, pl. 20, f. 4, '89; Bull. 37, U. S. N. M., p. 140, pl. 20, f. 4, pl. 52, f. 1, '89; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 126, 1915.

emersoni C. B. Adams, Jour. Bost. Soc. N. H., 2, p. 284, pl. 4, f. 10, 1838, (as *Cerithium*) Verrill, Inv. Vineyard Sound, p. 648, pl. 24, f. 151, 1873.

punctatum Philippi, 1848. Not of Bruguiere, 1789.

Distribution.—Massachussetts to Grenada, W. I. Gulf of Mexico, Cedar Keys, Texas and Yucatan. 2-15 fms. Pliocene of the Caloosahatchie.

Genus **SEILA** A. Adams

adamsi H. C. Lea, Tr. Amer. Phil. Soc. 2d ser. 9, p. 42, 1845, (as *Cerithium*); Dall, Tr. W. I. S., 3, p. 267, 1892; Vanatta Pr. A. N. S. Phila., 55, p. 758, 1903; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 127, 1915.

terebralis C. B. Adams, Jour. Bost. Soc. N. H., 3, p. 320, pl. 3, f. 7, 1840 (as *Cerithium*); De Kay, N. Y. Moll, p. 130, pl. 8, f. 172,'43; Dall, Bull. M.C. Z., 18, p. 250, '89; Bull. U. S. N. M., p. 138, pl. 52, f. 5, '89. Not *Cerithium terebrale* Lamarck.

Distribution—Massachussetts to Samana Bay, Dominican Republic. 0-20 fms. Gulf coast: Cedar Keys, Fla.; Chandeleurs, La.; Galveston and Corpus Christi, Texas, 0-20 fms. Pleistocene, Gulf coast. Pliocene, Caloosahatchie River, Fla. Lower Miocene, Chipola marl, West Fla.

Genus **CERITHIUM** Bruguiere

floridanum Moerch, Mal. Blatt., 23, p. 114, 1876; Dall, Bull. 37, U. S. N. M., p. 140, '89; Tr. W. I. S., 3, p. 282, pl. 14, f. 10, 1892; Vaughan, Publ. No. 133, Carn. Inst., p. 171, 1910.

Distribution—Hatteras to Cuba and West Fla. Pleistocene, Labella, West Fla. Pliocene, Calaosahatchie beds.

algicola C. B. Adams, Pr. Bost. Soc. N. H., 2, p. 5, '48; Tryon, Man., 9, p. 129, pl. 22, f. 81, 82, '87; Dall, Tr. W. I. S., 3, p. 282, '92.

Distribution.—Tampa and Charlotte Harbor, West Florida to Jamaica. Between tides. Pliocene, Caloosahatchie beds.

litteratum Born, Mus. Cæs. Vind., p. 323, pl. 11, f. 14, 15, 1780; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 425, 1901.

Distribution.—East and West Florida, Antilles and Europe.

muscarum Say, Amer. Conch., 5, pl. 49, f. 1, 1832; Tryon, Man., 9, p, 132, pl. 23, f. 12, 13, '87; Dall, Tr. W. I. S., 3, p. 282, Vaughan, 2d Ann. Rept. Fla. G. S., p. 148, 1909.

Distribution.—Florida to Jamaica. Gulf coast: Cedar Keys and St. Mark's, Fla.; Chandeleurs, La. Pleistocene, Manatee, Labelle and North Creek, Fla. Pliocene, Caloosahatchie beds.

variable C. B. Adams, Pr. Bost. Soc. N. H.. 2, p. 5, 1848; Sowerby, Conch. Icon., 15, pl. 13, f. 91, 1865; Dall, Bull. 37, U. S. N. M., p. 140, 1889; Mitchell, List Texas Shells.

Distribution.—Tampa, Fla.; Galveston, Corpus Christi, Carancahua and Espiritu Santo Bays, Tex. South to the Antilles and Curacoa.

minimum Gmelin, Syst. Nat., p. 3564, 1792, (as *Murex*); Tryon, Man., 9, p. 167, pl. 34, f. 9-11, 1887; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 426, 1901.

Distribution.—Tampa, Fla., to Guadeloupe Isl.

minimum var. **nigrescens** Menke, Synopsis, p. 85, 1828; Dall, Bull. 37, U. S. N. M., p. 140, '89.

Distribution.—Tampa to Venezuela.

eburneum Bruguiere, Ency. Me'th., pl. 442, f. 1a, b; Tryon, Man., 9, p. 129, pl. 61, f. 71, 72, 1887; Dall, Bull. 37, U.S. N. M., p. 140, 1889; Singley, 4th Ann. Rept. Texas Surv., p. 339, 1892.

Distribution.—Florida to the Swan Isls. Cited by Singley from Corpus Christi, Texas.

galvestonense Harris, Bull. Amer. Pal, vol. 1, p. 104, pl. 4, f. 9, 9a, 1895.

Distribution.—Upper Miocene, Galveston well at 2236-2920 feet.

Genus **CLAVA** Martyn

chipolana Dall, Tr. Wagner Inst. Sci., 3, p. 290, pl. 22, f. 8, 1892.

Distribution.—Lower Miocene of the Chipola marl, Alum Bluff, Fla., and of the Bacom well, Mobile, Ala., at 1241 ft., Chipola horizon.

Genus **CERITHIDEA** Swainson

costata Wood, Mal. Blatt., 23, p. 90; Dall, Pr. U. S. N. M., 6, p. 334, 1883; Bull. 37, U. S. N. M., p. 140, '89.

Distribution.—Tampa, West Fla., to St. Thomas and Jamaica.

scalariformis Say, Jour. A. N. S. Phila., p. 128, 1825; Tryon, Man., 9. p. 163, pl. 33, f. 78, '87; Dall, Bull. 37, U. S. N. M., p. 140, '89.

Distribtion.—Georgia to Cedar Keys, West Fla.

varicosa Sowerby, Genera Shells, No. 42, f. 5; Dall, List Cameron Shells; Bull. M. C. Z., 18, p. 259,'89

Distribution.—Texas, Breton Island, Chandeleurs, La., and south to Cuba and Jamaica.

turrita Stearns, Pr. Bost. Soc. N. H., 15, p. 24, 1872; Tryon, Man., 9, p. 164, pl. 34, f. 83, '87; Dall, Tr. W. I. S., 3, p. 290,1892.

Distribution.—Cedar Keys, Fla., to the Bahamas. Pliocene of Shell Creek, Fla.

hegewishi Philippi, Mal. Blatt., 23, p. '89; Zeitschr. fur Malak., p. 19, 1841; Singley, 4th Ann. Rept. Tex., p. 339, 1892; Mitchell, List Tex. Sh.

Distribution.—Cited by Singley and Mitchell from Matagorda, Carancahua and Corpus Christi Bays, Texas.

Genus **POTAMIDES** Brongniart

matsoni Dall, Pr. U. S, N. M., 46, p. 231, pl. 21, f. 1, 2, 7, 1914.

Distribution.—Well near Alexandria, La., at 49 feet; well at Pine Prairie, La., at 1540 feet; surface near Burkeville, Texas.

Note.—The brackish water molluscan fauna of Burkeville, Texas; Alexandria and Pine Prairie, La., was referred in 1914 by Dr. Dall to the Pliocene. Dr. W. D. Matthew thought the mammalian remains (tibia of a rhinoceros and upper molar of a horse, either *Protohippus* or *Merychippus*) indicated a Late Miocene or Early Pliocene age. For discussion of the Burkeville beds (lower member of the Fleming clay) see Dumble, Univ. Tex. Bull. No. 1869,pp. 224-225, 1918. The stratigraphic relation of the Burkeville beds rather suggests an Upper Miocene horizon.

matsoni var. **gracilior** Dall, Pr. U. S. N. M., 46, p. 231, 1914.

Distribution.—Well near Alexandria, La., at 49 feet; well at Pairie Bluff, La.; near Burkeville, Tex.

Genus **ALABINA** Dall

adamsi Dall, Bull. M. C. Z., 18, p. 258, '89; Bull. 37, U. S. N. M., p. 140, '89; Tr. W. I. S., 3, p. 276, '92, (All as *Bittium*).

Distribution.—Hatteras to Haiti and West Florida, moderate depths. Pliocene. Caloosahatchie River and Shell Creek, West Fla.

cerithioides Dall, Bull. M. C. Z., 18, p. 258, '89; Bull. 37, U. S. N. M., p. 140, '89; Tr. W. I. S., 3, p. 276, pl. 16, f. 8, '92; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 427, 1901. (All as *Bittium cerithioide*).

Distribution.—Cape Lookout, N. C.. to Samana Bay, Dominican Republic. Singley lists with a question a shell from Corpus Christi, Tex. Pliocene, Caloosahatchie River, Fla.

Genus **BITTIUM** (Leach) Gray

varium Pfeiffer, Arch. fur Naturg., p. 256, No. 139, 1840, (as *Cerithium*); Tryon, Man., 9, p. 152, pl. 29, f. 86, '87; Dall, Tr. W. I. S., 3, p. 274, '92; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 426, 1901.

gibberulum C. B. Adams, Pr. Bost. Soc. N. H,, p. 5, 1845; Sowerby's Thes., p. 876, f. 210, 211, (as *Cerithium*).

Distribution.—Chesapeake Bay to St. Thomas, W. I. Gulf coast: Cedar Keys, Fla.; Chandeleurs, La.; Corpus Christi, Galveston and Laguna Madre, Tex. Pleistocene, North Beach. Fla. Pliocene, Caloosahatchie and Shell Creek, Florida.

Note.—*Bittium nigrum* Totten, synonym of *B. alternatum* Say, has been erroneously reported from Cedar Keys, Fla. and Chandeleurs, La. These specimens were probably *varium*. True *alternatum*, *fide* Dall, does not extend southward of New York Harbor.

boiplex Dall, Tr. W. I. S., 3, p. 275, pl. 21, f. 14, '92.

Distribution.—Lower Miocene, Chipola marl, Fla., and of the Basom No. 1 well, Mobile, Ala. at 1500-1556 ft., Chipola horizon, Aldrich's collection. A varietal form.

galvestonense Harris, Bull. Amer. Pal.,vol. 1, p. 104, pl. 4, f. 8, 1895.

Distribution.—Upper Miocene, Galveston well at 2550-2871 feet.

Genus **MODULUS** Gray

modulus Linnæus, Syst. Nat.. ed. X, p. 757, 1758, (as *Trochus*); Dall, Bull. 37, U. S. N. M., p. 142, 1889; Singley, 4th Ann. Rept. Tex. G. S., p. 339, '92; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 427, 1901.

lenticularis Chemnitz, Tryon, Man., 9, p. 261, pl. 48, f. 91,92, 1887.

Distribution.—Hatteras to Brazil and to Cartagena, Colombia. Gulf coast: West Florida, Chandeleurs, La.; Galveston, Corpus Christi, and Espiritu Santo Bay, Tex. Between tides. Pliocene, Caloosahatchie and Shell Creek, Fla. Upper Miocene, Galveston well at 2552-2871 feet (identification doubtful).

floridanus Conrad, Amer. Jour. Conch., 5, p. 107, pl. 12,f. 6, '70; Hilgard, House of Rep. Ex. Doc., 1, pt. 2, p. 887, 1878; Dall, Pr. U. S. N. M., 6, p. 335, '83; Bull. 37, U. S. N. M., p. 142, '89; Tr. W. I. S., 3, p. 295, '92; Vaughan, Publ. No. 133, Carn. Inst., p. 171, 1910.

Distribution.—Hatteras to St. Thomas, W. I. Gulf coast, Cedar Keys and St. Mark's, West Fla. Pleistocene, Lake Borgne borings, La., and North Creek and Labelle, Fla. Pliocene, Caloosahatchie beds, Fla. and of the New Orleans Gymnasium club well at 1200 feet.

Genus **PACHYCHEILUS** Lea

anagrammatus Dall, Proc. U. S. N. M., 46, p. 232, pl. 21, f, 5, 8, 1914.

Distribution.—Upper Miocene or Pliocene. Well near Alexandria, La., at 49 feet. Also near Burkeville, Texas, surface exposure. Brackish water formation.

satillensis Aldrich, The Nautilus, 24, pt. 11, p. 132, pl. 8, f. 1, 1a-c, 1911, (as *Potamides*); Dall, Pr. U. S. N. M., p. 232, 1914,

Distribution.—Upper Miocene or Pliocene. Satilla River, Ga., and Burkeville, Tex. Brackish water formation.

suavis Dall, Proc. U. S. N. M., 46, p. 232, pl. 21, f. 6, 9, 1614.

Distribution.—Upper Miocene or Pliocene. Well near Alexandria, La., at 49 feet, and well, Pine Prairie oil field, La., at 1540 feet. Also surface exposure, Burkeville, Tex.

Genus **CAECUM** Fleming

floridanum Stimpson, Pr. Bost. Soc. N. H., 4, p. 112, 1851; Tryon, Man., 8, p. 217, pl. 66, f. 62, '86; Dall, Bull. 37, U. S. N. M., p. 142, '89; Tr, W. I. S. 3, p. 298, '92.

irregulare de Folin, Jour. de Conch., 15, p. 46, pl. 3, f. 6, 1867.

annulatum Emmons, Rept. Geol. N. Car., p. 274, f. 190,' 58. Not of Brown, 1844.

Distribution.—Hatteras to Bahia, Brazil. Also West Fla. 2-18 fms. Pliocene, Caloosahatchie, Fla.

instructum de Folin, Fonds de la Mer; Dall, Bull. 37, U. S. N. M., p. 142, '89.

Distribution.—Hatteras to Tampa, West Fla. Pliocene to Recent.

bipartitum de Folin, Fonds de la Mer; Dall, Bull. 37, U. S. N. M., p. 142, '89.

Distribution.—Hatteras and West Florida.

carolinianum Dall, Trans. Wagner Inst. Sci., 3, p. 300, pl. 22, f. 25, 1892; Bull. 37, U. S. N. M., p. 142, 1889, (name only).

Distribution.—Hatteras to Tortugas and to Egmont Key, West Fla. 2-63 fms. Pliocene, Caloosahatchie River, Florida.

glabrum Montagu, Test. Brit., 2, p. 497, 1803, (as *Dentalium*); Tryon, Man., 8, p. 215, pl. 66, f. 57, 1886; Dall, Bull. 37, U. S. N. M., p. 142, '89.

Distribution.—North Carolina to Tampa, West Fla. Also European. Pliocene of the Caloosahatchie and of England. Miocene of York town, Va.

cooperi Sanderson Smith, Ann. & Lyc. N. Hist. N. Y., 7, pp. 154, 168, 1862; 9, p. 393, f. 3, 1870; Tryon, Man., 8, p. 221, pl. 67, f. 84, '85; Dall, Tr. W. I. S., 3, p. 299, 1892; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 124, 1915.

costatum Verrill, Am, Jour. Sci., (3) 3, p. 283, pl. 6, f. 6, 1872.

Distribution.—Massachussetts to the Antilles. Gulf coast: Crooked Island, Calhoun Co., West Fla. Pliocene of the Caloosahatchie and Shell Creek, West Fla.

pulchellum Stimpson, Pr. Bost. Soc. N. H., 4, p. 112, 1851; Shells of New England, p. 36, pl. 2, f. 3; Hilgard, House of Rep. Ex. Doc., 1, pt. 2, p. 886, 1878. Tryon, Man., 8, p. 217, pl. 66, f. 63, '86; Dall, Bull. 37, U. S. N. M., p. 142, pl. 50, f. 22, '89; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 123, 1915.

Distribution.—Cape Cod, Mass., to the Tortugas. Gulf coast: Crooked Island, Calhoun Co., Fla. Pleistocene, Lake Borgne, La., borings.

Genus **MEIOCERAS** Carpenter

deshayesi de Folin, Annales Soc. Linn. Maine et Loire, 11, '69, Dall, Bull. 37, U. S. N. M., p. 142, '89.

Distribution.—Tampa, West Fla., to Jamaica, W. I.

undulosum de Folin, Ann. Soc. Linn. Maine et Loire, 11, 1869; Dall, Bull. 37, U. S. N. M., p. 142, '89.

Distribution.—Charlotte Harbor, West Fla. to Jamaica. Pliocene to Recent.

nitidum Stimpson, Pr. Bost. Soc. N. H., 4. p. 112, 1851, (as *Caecum*); Tryon, Man.. 8, p. 222, pl. 67, f. 73, '86; Dall, Tr. W. I. S., 3, p. 302, 1892; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903.

Distribution.—West Florida, at Tampa and Crooked Isl. (Calhoun Co.), to Jamaica.

Genus **BIVONIA** Gray

exerta Dall, Bull. M. C. Z., Harvard Coll., 9, p. 39, 1881; 18, p. 264, pl. 26, f. 6, '89; Bull. 37, U. S. N. M., p. 144, pl. 26, f. 6, '89.

Distribution.—Cape Lookout, N. C., to Barbados. Gulf of Mexico, West Florida and Texas regions, deep water. 31-1002 fms.

Genus **VERMICULARIA** Lamarck

spirata Philippi, Arch. fur Naturg. 2, pt. 1, 224, pl. 7, f. 1, 1836, (as *Vermiculus*); Tryon, Man., 8, p. 187, pl. 55, f. 99, 100, '86; Dall, Bull. 37, U. S. N. M., p. 144, pl. 51, f. 4, '89; Tr. W. I. S., 3, p. 304, '92; Singley, 4th Ann. Rept. G. S. Tex., p. 340, '92. Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 123, 1915.

Distribution.—Massachussetts to the West Indies. Gulf coast: West Florida; Matagorda and Corpus Christi Bays, and Quintana, Tex. Pliocene of Shell Creek, &c, Fla.

Note.—Moerch described as *V. melanosclera* (Pr. Zool. Soc., p. 174, 1861) a form from Vera Cruz which Tryon regarded as a variety of *spirata*, and on the same page of the Proceedings Moerch described *V. quadrangularis* from Yucatan. This was also regarded by Tryon as a variety of *spirata* (See

Tryon's Manuel, 8, p. 187, 1886). Shells from the Gulf, Blake station 36, at 24 fms., have been referred by Dall to *V. lumbricalis* Linn. (See Bull. M. C. Z., 18, p. 261, '89) but the true Linnæan *lumbricalis* is Oriental.

nigricans Dall, Pr. U. S. N. M., 6, p. 334, 1883, (as *lumbricalis* var.); Bull. 37, U, S. N. M., p. 144, '89.

Distribution.—West Florida and Texas. 2-14 fms.

Genus **PETALOCONCHUS** Lea

irregularis d'Orbigny, Moll, Cuba, 1, p. 235, pl. 17, f. 16, 18,'42, (as *Vermetus*); Dall, Bull. 37, U. S. N. M., p. 144, 1889; Tr. W. I. S., 3. p. 304, '92.

Distribution.—Gulf of Mexico between Mississippi delta and Cedar Keys, Fla., at 27 fms. Also Antilles to Guadeloupe. Pleistocene of Fla. Pliocene, Caloosahatchie beds.

varians d'Orbigny, Voy. Ame'r Me'rid., p. 456, pl. 54, f. 7-10, 1843; Tryon, Man., 8, p. 170, pl. 49, f. 22, 23, '86; Dall, Tr. W. I. S., 3, p. 305, '92.

Distribution.—Southwest Florida to Rio de Janeiro. Pliocene, Caloosahatchie beds. Oligocene, Tampa silex beds.

erectus Dall, in Agassiz, Three Cruises of the Blake, 2, p. 71, f. 297,'88; Bull, M. C. Z., 18, p. 262, pl. 38, f. 4, '89; Bull. 37, U. S. N. M., p. 144, pl. 38, f. 4, '89.

Distribution.—Antilles and West Florida. 37-805 fms. Pliocene, Caloosahatchie River, Fla.

Genus **SIPHONIUM**

nebulosum Dillwyn, 2, p. 1076, No. 19; Tryon, Man., 8. p. 184, pl. 54, f. 87, 1886; Dall, Bull. 37, U. S. N. M., p. 144, '89.

Distribution.—East and West Florida to Tortola.

Genus **SILIQUARIA** Bruguiere

squamata Blainville, Dict. des Sci. Nat., 49, f. 213; Tryon, Man., 8, p. 190, pl. 58, f. 25, '86; Dall, Bull. 37, U. S. N. M., p. 144, '89.

Distribution.—Sarasota, West Florida, to Barbados. 2-163 fms.

modesta Dall, Bull. M. C. Z., Harv. Coll., 9, p. 39, '81; Agassiz, Three Cruises of the Blake, 2, p. 71, f. 296, '88; Dall, Bull. M. C. Z., 18, p. 260, pl. 26, f. 4, '89; Bull. 37, U. S. N. M., p. 144, pl. 26, f. 4, '89.

Distribution.—Off Cedar Keys, West Florida, to Curacoa Isl. 94-805 fms.

Genus **TURRITELLA** Lamarck

(Haustator) variegata Linnæus, Syst. Nat., ed. X, p. 767, 1758, (as *Turbo*);Reeve, Conch. Icon., 5, pl. 5, f. 19, '49; Tryon, Man., 8, p. 198, pl. 61, f. 58, '86; Dall, Bull. 37, U. S. N. M., p. 144, '89.

Distribution.—Matagorda and Espiritu Santo Bays, Texas to Cartagena, Colombia, and Antilles. Pleistocene Knapp's wells, Terrebonne Parish, La., No. 1 at 1660-1700, 2250-2450 (?), No. 2 at 1434-1800, No. 3 at 1330-1375 feet.

(Haustator) yucatecana Dall, Bull. M. C. Z., 9, p. 93, 1881; 18, p. 265, pl. 26, f. 3, '89; Bull. 37, U. S. N. M., p. 144, pl. 26, f. 3, '89.

Distribution.—Gulf of Mexico, Yucatan Strait, 640 fms.

(Torcula) exoleta Linnæus, Syst. Nat., ed, X, p. 766, 1758, (as *Turbo*); Reeve, Conch. Icon., 5, pl. 6, f. 22, 1849; Tryon, Man., 8, p. 205, pl. 98, 99, 1886; Dull, Bull. 37, U. S, N. M., p. 144, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 429, 1901.

Distribution.—West Florida, in 50 fms.; Texas coast. Antilles to Barbados. 45-170 fms.

(Torcula) acropora Dall, Bull. M. C. Z., 18, p. 264, 1889; Bull. 37, U. S. N. M., p. 144, '89.

Distribution.—Hatteras to Grenada Isl. Gulf of Mexico, West of Florida, at 14-50 fms., and the coast of Texas, Vera Cruz and Yucatan. 3-413 fms. The Pliocene, closely related form is *T. subannulata* Heilprin of the Caloosahatchie marl.

chipolana Dall, Trans. Wagner Inst. Sci., 3, p. 312, pl. 22, f. 24, 1892.

Distribution.—Lower Miocene of the Chipola beds, West Florida, and of the Bascom No. 2 well, Mobile, Ala., at 1241 feet, Chipola horizon. Aldrich's collection.

subgrundifera Dall, Trans. Wagner Inst. Sci., 3. p. 313, pl. 22, f. 23, 1892.

Distribution.—Lower Miocene, Chipola beds, Calhoun Co., West Fla., and of the Bascom No. 2 well, Mobile, Ala., at 1241 feet, Aldrich's collection. A varietal form was recorded by Harris from the Upper Miocene, Galveston well, at 2552-2920 feet.

terebriformis Conrad, Cat. Mio. Foss., Pr. A. N. S. Phila., p. 568, 1863, (Name only); Dall, Tr. W. I. S., 3, p. 311, 1892.

Distribution.—Lower Miocene, Chipola marl, Fla., and of the Bascon No. 1 well, Mobile, Ala., at 1500-1556 feet. Aldrich's collection. Also Chesapeake Miocene of Easton, Md. (Conrad's type locality).

satilla Dall, Proc. U. S. N. M., p. 233, pl. 22, f. 6, 1914.

Distribution.—Upper Miocene or Pliocene.. Well near Alexandria, La., at 49 feet. Brackish water formation.

Genus **MATHILDA** Semper

yucatecana Dall, Bull, M. C. Z., 9,p. 90, 1881, (as *Bittium*); 18, p. 266, pl. 20, f. 7, '89; Bull. 37, U. S. N. M., pl. 20, f. 7, '89.

Distribution.—Gulf of Mexico, Yucatan Strait, 640 fms.

Also off Georgia and Fernandina, East Florida. Least depth, 294 fms.

Genus **LITTORINA** Ferussac

ziczac Gmelin, Syst. Nat., p. 3587, 1792, (as *Trochus*); Reeve, Conch. Icon., 10, pl. 11, f. 57, 1857; Tryon, Man., 9, p, 251, pl. 45, f. 5, 1887; Dall, Bull. 37, U. S. N. M., p. 146, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 429, 1901.

Distribution.—Florida Keys west to Texas and South to Barbados.

augulifera Lamarck, Anim. s. Vert., 7, p. 54, 1882, (as *Phasianella*); Dall, Bull. 37, U. S. N. M., p. 146, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 430, 1901.

Distribution.—West Florida and Texas to the Antilles and Cartagena, Colombia.

mespilum Muhlfeld, Verh, Berl. Ges. Nat., 1, p. 219, pl. 8, f. 8, 1824, (as *Helix*); Tryon, Man., 9, p, 252, pl. 45, f. 16, 1887; Dall, Bull. 37, U. S. N. M., p. 146, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 430, 1901.

Distribution.—Texas to Barbados.

irrorata Say, Jour. A. N. S. Phila., (1), 2, p. 239, 1822, Tuomey and Holmes, Pl. Foss. S. Car., p. 119, pl. 26, f. 5, 1857; Post.—Pl. Foss. S. Car., p. 91, pl. 14, f. 5, 1860; Tryon, Man., 9, p. 246, pl. 43, f. 48, '87: Dall, Bull. 37, U. S. N. M., p. 146, pl. 69, f. 6, '89; Tr. W. I. S., 3,p. 320, '92; Singley, 4th Ann. Rept. G. S. Texas, p. 340, '92: Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903; Johnson, Occ. Pa, Bost. Soc. N. H., 7, p. 121, 1915.

Distribution.—Massachussetts to Jamaica. Culf coast: Cedar Keys, and Calhoun and Washington Cos., West Fla., Chandeleurs, Weeks Island, Point au Fer, La.; Matagorda, Espiritu Santo Bays and Galveston, Tex. Pleistocene, New Orleans pumping station No. 7.

Fenus **LITIOPA** Rang

bombix Kiener, Ann. des Sci. Nat.,p. 203, 1829; Ann. des Sci., 30, p. 222, pl. 17, B. f. 1-3, 1833; Tryon, Man., 9, p. 281, p. 53, f. 74, 1887; Dall, Bull. 37, U. S. N. M., p. 148, '89; Singley, 4th Ann. Rept. Tex., p. 340, '92; Dall, Bull. 112, U. S. N. M., p. 155, 1921, Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 119, 1915.

melanostoma (Rang) Sumner, Bull. U. S. Bur. Fish., 31, pt. 2, p.720, 1913.

Distribution.—New England to Brazil. Gulf coast at Cameron, La.; Corpus Christi and Galveston, Tex. Also Pacific, California coast. Pelagic on floating *Sargassum.*

Genus **TECTARIUS** Valenciennes

muricatus Linnæus, Syst. Nat., ed X, p. 1758, (as *Turbo*); Reeve, Conch. Icon., 10, pl. 2, f. 11, 1857, (as *Littorina*); Tryon, Man., 9, p. 258, pl. 48, f. 68, 1887; Dall, Bull. 37, U. S. N. M., p. 146, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 431, 1901.

Distribution.—East Florida and West Florida and Antilles to Colon.

Genus **ECHINELLA** Swainson

nodulosa Pfeiffer, Tryon, Man., 9, p. 258, pl. 48, f. 75, 1887, (Excl. syn.); Dall, Bull. U. S. N. M., p. 146, '89; Dall, and Simpson, Bull, U. S. Fish Com., 1, p. 431, 1901.

Distribution.—North Carolina to Barbados and Texas.

Genus **ISAPIS** H. & A. Adams

ebsoleta Dall, Proc. U. S. N. M., 46, p. 233, pl. 22, f. 8, 1914.

Distribution.—Upper Miocene or Pliocene. Well near Alexandria, La., at 49 feet.

Genus **ALABA** A. Adams

tervaricosa C. B. Adams, Pr. Bost. Soc., N. H., 2, p. 6, 1845, (as *Rissoa*); Moerch, Malak, Blatt., 23, p. 57, 1876; Dall, Bull. U. S. N. M., p. 146, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 431, 1901.

Distribution.—Tampa, West Fla., to Haiti.

Genus **ARCHITECTONICA** Bolten

granulata Lamarck, Anim. s. Vert., 7, p. 3, 1822; Ency. Me'th., pl. 446, f. 5a-b, 1792, (as *Solarium*); Dall, Tr. W.I.S., 3,p. 329, 1892; Pr. U. S. N. M., 37, p. 232, 1910; Maury, Bull. Amer. Pal., No. 29, p. 131, pl. 23, f. 3, 1917.

perspectiva Tuomey and Holmes, Pl. Foss. S. Car., p. 120, pl. 26, 1857. Not of Linnæus nor Lamarck.

Distribution.—Hatteras to the Antilles. Gulf coast at Chandeleurs, La., Matagorda and other localities, Tex. Also Pacific Ocean, Lower California to Peru. Pleistocene, New Orleans pumping station No. 7; Upper Miocene, Galveston well at 2158-2871 feet. Lower Miocene, Chipola marl, West Fla., and Dominican Republic.

Genus **TORINIA** Gray

cylindrica Gmelin, Syst. Nat., p. 3572, 1792, (as *Trochus*); Tryon, Man., 9, p. 17, pl. 5, f. 82, 1887; Dall, Bull. 37, U. S. N. M., p. 148, '89; Dall and Sampson, Bull. U. S. Fish Com., 1, p. 432,1901.

Distribution.—Texas to St. Thomas, W. I.

canalifera C. B. Adams. Dall, Bull. 37, U. S. N. M., p. 148, 1889.

Distribution.—Texas to Guadeloupe.

Genus **RISSOA** Fre'minville

precipitata Dall, Bull. M. C. Z., 18, p. 279, pl. 19, f. 1, 1889; Bull. 37, U. S. N. M., p. 148, pl. 19, f. 1, '89.

Distribution.—Gun Cay, East Fla., 498 fms., Yucatan Strait at 640 fms.

acuticostata Dall, Bull. M. C. Z., 18, p. 280, pl. 19, f. 10, 1889; Bull. 37, U. S. N. M., p. 150, pl. 19, f. 10, '89.

Distribution.—Yucatan Strait, 640 fms., and between Mississippi delta and Cedar Keys, 32 fms. Also off Hatteras and Barbados. Probably a variety of *R. xanthias* Watson (Chall Gastr., p. 588, pl. 44, f. 5, 1885).

Genus **RISSOINA** d'Orbigny

decussata Montagu, Test. Brit., p. 399, 1803, (as *Turbo*); Schwartz von Mohrenstern, Denkschr. d. Kais. Akad. d. Wissensch. Wien. 19, p. 80, f. 12, 1860; Tryon, Man., 9, p. 385, pl. 58, f. 15, 1887; Dall, Bull. M. C. Z., 18, p. 281, '89; Tr. W. I. S., 3, p. 343, '92.

Distribution.—Cape Fear, N. C., to Haiti and to West Fla. 2-17 fms. Also European. Variety *planata* Dall, Caloosahatchie Pliocene.

laevigata C. B. Adams, Contr. Conch., p. 114, 1850; Schwartz von Mohrenstern, Denk. Kais. Ak. Wien., 19, p. 111, f. 79, 1860; Tryon, Man., 9, p. 390, pl. 59, f. 48, '87; Dall, Tr. W. I. S., 3, p. 342, '92.

Distribution.—Cape Lookout, N. C., to St. Thomas, W. I. Also West Florida. 0-22 fms. Pliocene, Caloosahatchie beds. Lower Miocene, Chipola beds, West Fla.

chesneli Michaud, Descr. des Coq. Nouv., p. 17, 1832, (as *Rissoa*); Tryon, Man., 9, p. 380, pl. 56, f. 73, '87; Dall, Tr. W. I. S., 3, p. 343, '92; Singley, 4th Ann. Rept. Tex., p. 341, '92.

Distribution.—Hatteras to Guadeloupe, Gulf coast: Cedar Keys, Fla.; Corpus Christi, Tex. Also Mediterranean and Mauritius. Pliocene, Caloosahatchie beds, West Fla.

browniana d'Orbigny, Moll, Cuba, 2, p. 28, pl. 12, f. 33, 35, '42;

Tryon, Man., 9, p. 390, pl. 59, f. 45, '87; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903.

Distribution.—West Indies and Gulf coast, Crooked Island, Calhoun Co., West Fla. (Vanatta).

elegantissima d'Orbigny, Moll. Cuba, 2, p. 26, pl. 12, f. 27-29, 1853; Tryon, Man., 9, p. 374, pl, 56, f. 51. 1887.

Distribution—West Indies and Gulf coast, Chandeleurs, La. (Dall).

sagraiana d'Orbigny, Moll. Cuba, 2, p. 25, pl. 12, f. 4, 5, 1852; Tryon, Man., 9, p. 384, pl. 57, f. 86, 1887; Dall, Bull. 37, U. S. N. M., p. 150, '89.

Distribution.—Florida Strait, to Martinique. Also Gulf coast at Vera Cruz, Mex.

Genus BENTHONELLA Dall

nisonis Dall, Bull. M. C. Z., 18, p. 283, 1889; Bull. 37, U. S. N. M,, p. 150, '89.

Distribution.—Gulf of Mexico between Mississippi delta and Cedar Keys at 940 fms.

gaza Dall, Bull. M. C. Z., 18, p. 282, '89; Bull. 37,U. S. N. M., p. 150, pl. 42, f. 5, '89.

Distribution.—Georgia to Cuba, West Florida and Texas regions of the Gulf. 6-463 fms.

fischeri Dall, Bull. M. C. Z., 18, p. 282, '89; Bull. 37, U. S. N. M., p, 282, '89.

Distribution.—Gulf of Mexico between Mississippi delta and Cedar Keys at 940 fms., bottom temperature 39° F. Also off Cuba.

Genus SKENEA Fleming

planorbis Fabricius, Fauna Groenlandica, p. 394, 1780; Gould, Inv. Mass., p. 296, f. 563, 1870; Dall, Bull. 37, U. S. N. M., p. 150, pl. 52, f. 18, 1889; Bush, Tr. Conn. Acad. Sci., 10, p. 100, pl. 23, f. 5, 8, '99-1900; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 119, 1915.

Helix depressus Montagu.

Distribution.—Greenland (type locality) to Charlotte Harbor, West Florida. This species is the genotype.

Genus **AMPULLARIA** Lamarck

depressa Say, Dall, Bull. 37, U. S. N. M., p. 150, '89.

Distribution.—Georgia to West Florida, Texas and Mexico.

caliginosa Reeve, Conch. Icon., Mon. *Ampullaria*, f. 118, pl. 25, 1856; Dall, Proc. U. S. N. M., 8, p. 255, 1885; Bull. 37, U. S. N. M., p. 150, 1889.

Distribution.—Cedar Keys, West Florida to Texas, Mexico and Nicaragua. In freshwater swamps.

pinei Dall, The Nautilus, p. 75, Nov. 1898.

Distribution.—Homosassa River, Fla.

Genus **PALUDESTRINA** d'Orbigny

aldrichi Dall, Proc. U. S. N. M., 46, p. 234, pl. 22, f. 7, 1914.

Distribution.—Upper Miocene or Pliocene. Well near Alexandria, La., at 49 feet. Brackish water formation.

plana Aldrich, Nautilus, 24, pt. 12, p. 139, pl. 8, f. 3, 1911; Dall, Pr. U. S. N. M., 46, p. 234, 1914.

Distribution.—Upper Miocene or Pliocene. Well near Alexandria, La., at 49 feet. Also Satilla River, Ga., (type locality).

curva Dall, Proc. U. S, N. M., 46, p. 235, pl. 22, f. 4, 1914.

Distribution.—Upper Miocene or Pliocene. Well near Alexandria, Ga., at 49 feet.

cingulata Dall, Proc. U. S. N. M., 46, p. 235, pl. 22, f. 1, 1914.

Distribution.—Upper Miocene or Pliocene. Well near Alexandria, La., at 49 feet.

turricula Dall, Proc, U. S. N. M., 46, p. 235, pl. 22. f. 9, 1914.

Distribution.—Upper Miocene or Pliocene. Well near Alexandria, La., at 49 feet. Brackish water formation.

milium Dall, Proc. U. S. N. M., 46, p. 235, pl. 22, f. 2, 1914.

Distribution.—Upper Miocene or Pliocene.. Well near Alexandria, La., at 49 feet.

Genus **ASSIMINEA** Leach

auberiana d'Orbigny, Moll. Cuba, 2, p. 8, pl. 10, f. 6, 7, 1842, (as *Paludestrina*); Dall, Pr. U. S. N. M., 6, p. 335, 1883; Bull. 37, U. S. N. M., p. 150, '89; Tr. W. I. S. 3, p. 347, 1892.

Distribution.—Cedar Keys, West Florida, and the Antilles. Pliocene, Caloosahatchie and Shell Creek, West Fla.

Genus **TRUNCATELLA** Risso

caribaeensis Sowerby (MSS.); Reeve, Conch. Syst. 2, pl. 182, f. 7, 1842; Binney, Land & Fr-Water Shells, N. A. Smith. Misc. Coll., No. 144, pt. 3, p. 98, pl. 198, 1865; Dall, Bull. 37, U. S. N. M., p. 152, '89; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 436, pl. 53, f. 7, 1901.

Distribution.—West Florida, Alabama, Texas (?) and Mexico. Also Greater Antilles.

bilabiata Pfeiffer, Wiegm. Arch., 1, p. 253, 1840; Binny, L. and Fr. W. Sh. N. A., pt. 3, p. 99, f. 199, 1865; Dall, Bull. 37, U. S. N. M., p. 152, '89.

Distribution.—Sarasota, West Florida, to Honduras and Cuba.

pulchella Pfeiffer, Wiegm. Arch., 1, p. 356, 1839; Binney, L. and Fr. W. Sh. N. A., pt, 3, p. 99, f. 200, 1865; Dall, Bull. 37, U. S. N. M. p. 152, '89; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 436, 1901.

Distribution.—Florida to St. Thomas, W. I. Gulf coast:

Tampa, West Florida; Galveston, Texas. (Dr. Gurley).

subcylindrica Linnæus, Syst. Nat., ed. XII, p. 1248, 1767, (as *Helix*); Gray, in Turton, Man., p. 295, f. 72, 1857; Binney, Land and Fr. W. Sh. N. A., pt. 3, p. 100, f. 201, 1865; Dall and Simpson, Bull. U.S. Fish Com., p. 436, 1901.

Distribution.—Tampa, West Fla., to St. Thomas, W. I.

Genus **CHEILEA** Modeer

equestris Linnæus, Syst. Nat., ed. X, p. 780, 1758, (as *Patella*); Tryon, Man., 8, p. 137, pl. 41, f. 25, 26, 1886; Dall, Tr, W. I. S., 3, p. 348, '92, (as *Mitrularia*); Pr. U. S. N. M., 37, p. 232, 1910.

Distribution.—Hatteras to Barbados, Gulf of Mexico, Blake station 2. Also Pacific Ocean, Mexico to Chile. Pliocene, Caloosahatchie beds, Fla.

Genus **CAPULUS** Montfort

intortus Lamarck, Anim. s. Vert., 6, pt. 2, p. 18, 1822: d'Orbigny, Moll. Cuba, 1, p. 186, pl. 24, s. 22, 23, 1842; Tryon, Man., 8, p. 131, pl. 39, f. 75, '86; Dall, Bull. 37, U. S. N. M., p. 154, '89.

Distribution.—Gulf of Mexico, Blake station 5, at 229 fms. Also off Florida reefs, Hatteras and Bahamas.

Genus **CREPIDULA** Lamarck

fornicata Linnæus, Syst. Nat., ed. XII, 1, p. 1257, 1767, (as *Patella*); Hilgard, House of Rep. Ex. Doc., 1, pt. 2, p. 887, 1878; Dall, Bull. 37, U. S. N. M., p. 152, pl. 48, f. 16, pl. 50, f. 23, 24, 1889; Tr. W. I. S., 3, p. 356, '92; Singley, 4th Ann. Rept. Tex., p. 341, '92; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 109, 1915.

Distribution.—Granada to Cartagena, Colombia. Gulf coast: Cedar Keys, St. Mark's, Ft. Barranca, &c., West Fla., La., Galveston and Corpus Christi, Tex. Pleistocene, Lake

Borgne borings, New Orleans well of 1856, and New Orleans pumping station No. 7. Pliocene, Caloosahatchie beds. Lower Miocene Chipola beds, West Fla.

plana Say, Jour. A. N. S. Phila., (1), 2, p. 226, 1822; Tuomey and Holmes, Pl. Foss. S. Car., p. 111, pl. 25, f. 12, 1857; Dall, Bull., 37, U. S. N. M., p. 152, pl. 48, f. 12, pl. 50, f. 26, '89; Tr. W. I. S., 3. p. 358, '92: Vanatta, Pr, A. N. S. Phila., 55, p. 758, 1903; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 110, 1915.

Distribution.—Canada to Trinidad, W. I. Gulf coast: Cedar Keys, St. Mark's, Fla.; Chandeleurs, La.; Galveston, Corpus Christi and Matagorda Bays, Texas. Pleistocene, New Orleans pumping station No. 7 and North Creek, Fla. Pliocene, New Orleans Gymnasium Club well at 1200 feet, and Caloosahatchie beds, Fla. Lower Miocene Chipola beds, West Fla. and of the Bascom No. 1 well, Mobile, Ala., at 1500-1556 feet, Chipola horizon.

aculeata Gmelin, Syst. Nat., 7, p. 3693, 1792, (*Patella*); Tryon, Man., 8, p. 129, pl. 39, f. 61-62, 1886; Dall, Bull. M. C. Z., 18, p. 286, 1889; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903: Dall, Bull. 112, U. S. N. M., p. 162, 1921.

Distribution.—Cape Lookout, N. C., to Barbados. Gulf coast: Indian Pass, West Fla., and Texas. Usually 0-25 fms., but dredged in Gulf of Mexico, near Tortugas at 539 fms. Dwarfed and white at that depth. Also Pacific Ocean, California to Chile. Pliocene, Caloosahatchie beds, West Florida.

convexa Say, Jour. A. N. S. Phila., (1), 2, p. 227, 1822; Dall, Bull. 37, U. S. N. M., p. 152, pl. 50, f. 25, 1889; Tr. W. I. S., 3, p. 357, '92.

Distribution.—Nova Scotia to Florida. Gulf coast: West Fla.; Chandeleurs, La.; Galveston, Tex. Pleistocene, North Creek, West Fla.

Genus **CRUCIBULUM** Schumacher

auricula Gmelin, Syst. Nat., p. 3694, 1780, (as *Patella*); Dillwyn's Cat., 2, p. 1017, 1817; Dall, Bull. M. C. Z., 18, p. 284, '89; Bull. 37, U. S. N. M., p. 152, '89.

planatum Schumacher, Essai, p. 182, 1817.

scutellatum var. *auriculatum* (Chemn.) Tryon, Man., 8, p. 118, pl. 32, f. 34, 35, 1886.

Distribution.—Cedar Keys, West Fla., and Texas, south to Barbados and Northern Brazil, 25-111 fms. Pliocene, Caloosahatchie beds, West Fla. The analogous Pacific species is *C. spinosum*.

striatum Say, Jour. A. N. S, Phila., 5, p. 216, 1826; (as *Calyptraea*); Tryon, Man., 8, p. 118, pl. 33, f. 44, 45,'86; Dall, Bull. M. C. Z., 18, p. 284, '89; Johnson, Occ. Pa. Bost. Soc., N. H., 7, p. 109, 1915.

Distribution.—Nova Scotia to Florida. Cited by Dr. Dall from the Gulf of Mexico at Vera Cruz.

Genus **CALYPTRAEA** Lamarck

candeana d'Orbigny, Moll. Cuba, 2, p. 190, pl. 24, f. 28, 29, 1842, (as *Infundibulum*); Dall, Pr. U. S. N. M., 6, p. 335, '83, (as *Galerus*); Tryon, Man., 8, p. 121, pl. 34, f. 76, 77, 1886; Dall, Bull, 37, U. S. N. M., p. 152, '89.

parvulus Dunker, 1875.

Distribution.—Hatteras to Brazil. 6-52 fms. Gulf of Mexico, Cedar Keys, West Florida, and Yucatan Strait, 640 fms., dead shell.

Genus **XENOPHORA** Fischer de Waldheim

conchyliophora Born, Index Mus. Cæs., p. 333, 1778, (as *Trochus*); Tryon, Man., 8, p. 161, pl. 46, f. 89, '86; Dall, Bull. 37, U. S. N. M., p. 154, '89; Tr. W. I. S., 3, pp. 360-362, pl. 4, f. 10, 10a, '92; Bull. 90, U. S. N. M., p. 105, pl. 15, f. 1, 3, '15; Maury, Bull. Amer. Pal., No. 29, p. 133, pl. 23, f. 7, 1917.

agglutinans Lamarck.

Distribution.—Hatteras to the Antilles. Gulf of Mexico, West Florida and dredged at various stations, 14-229 fms. Usually not so deep as *X. caribaea* and more heavily loaded. Pliocene, Caloosahatchie beds, West Fla. Lower Miocene, Chipola marl, West Fla. Oligocene, Tampa silex beds, Fla. Upper Eocene, Jackson, Miss. Eocene, Wood's Bluff, Ala. Upper Cretaceous, (Ripley) of Prairie Bluff, Ala. The most ancient species of the Gulf Mollusca.

caribaea Petit, Jour. de Conch., 5, p. 248, pl. 10, f. 1, 2, 1856; Tryon, Man., 8, p. 162, pl. 47, f. 96, '86; Dall, Bull. M. C. Z., 18, p. 291, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 438, 1901.

Distribution.—Hatteras to Barbados and Gulf of Mexico, various stations, 14-274 fms.

Genus **NATICA** Scopoli

livida Pfeiffer, Wiegm. Arch., 6, p. 254, 1840; Moerch, Malak. Blatt., 24, p. 64, '77; Dall, Bull. M. C. Z., 18, p. 292, '89; Bull. 37, U. S. N. M., p. 154, '89.

jamaicensis C. B. Adams, Contr. Conch., p, 111, 1850.

proxima Sowerby, Thesaurus, *Natica*, pl. 8, f. 111. Not of C. B. Adams.

Distribution.—Hatteras to Barbados. Gulf of Mexico, between the Mississippi delta and Cedar Keys, 26 fms.

maroccana Chemnitz, Conch. Cab., 5, p. 270, pl. 188, f. 1905-10; Dillwyn, Cat. Rec. Sh., 2, p. 983, No. 13, 1817; Dall, Bull. M. C. Z., 18, p. 292, 1889; Bull. 37, U. S. N. M., p. 154, 1889.

Distribution.—Hatteras to Barbados and Gulf of Mexico, west of Florida. Also European and West African.

canrena Linnæus (in part) Syst. Nat., ed. X, p. 776, 1758, (as *Nerita*); Reeve, Conch. Icon., 9, pl. 4, f. 14, 1855; Tuomey and Holmes, Pl. Foss. S. Car., p. 115, pl. 25, f. 17, 1857; Dall, Bull. 37, U. S. N. M., p. 154, '89; Tr. W. I. S., 3, p. 364, '92; Maury, Bull. Amer. Pal., No. 29, p. 134, pl. 23, f. 10, 1917.

plicatella Conrad, Pr. A. N. S. Phila., p. 564, 1863.

Distribution.—Hatteras to the Antilles, Pernambuco and Cartagena. Gulf coast, West Florida and Galveston. Pliocene, Caloosahatchie beds, Upper Miocene, Galveston well at 2158-2920 feet. Lower Miocene, Bascom No. 2 well, Mobile, Ala., at 1241 feet, Chipola horizon.

alticallosa Dall, Trans. Wagner Inst. Sci., 3, p. 365, pl. 22, f. 28, 1892.

Distribution.—Lower Miocene, Chipola marl, Northwest Florida, and of the Bascom No. 2 well, Mobile, Ala. at 1241 feet, Chipola horizon.

Subgenus **Cryptonatica** Dall

pusilla Say, Jour. A. N. S. Phila., 2, p. 257, 1822; Hilgard House of Rep. Ex. Doc., 1, pt. 2, p. 886, 1878; Dall, Bull. 37, U, S. N. M., p. 154, pl. 50, f. 21, '89; Singley, 4th Ann. Rept. Tex., p. 341, '92; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 105, 1915.

Distribution.—Maine to Florida Keys. Gulf coast: St. Joseph's Bay and Crooked Island, West Fla., Galveston, Tex. Pleistocene, New Orleans artesian well of 1866, Lake Borgne borings, Knapp's wells, Terrebonne Parish, La., No. 3, at 1150-1200, 1330-1470, 1500-1525 feet. Pliocene Caloosahatchie beds, and of the New Orleans Gymnasium Club well at 1200 feet.

Genus **POLINICES** Montfort

Subgenus **Euspira** Agassiz

tenuis Recluz, Jour. de Conch., 1, p. 388, pl. 12, f. 7, 1850;

Tryon, Man., 8, p. 38, pl. 14, f. 25, '88; Dall, Bull. M. C. Z., 18, p. 295, '89; Bull. 37, U. S. N. M., p. 154, 1889; (All as *Lunatia*).

Distribution.—Gulf of Mexico, Yucatan Strait, 640 fms. Also off Cape Florida, Cape Fear and Cuba, 84-640 fms. Also Pacific Ocean, Valparaiso, Chile, Recluz's type locality.

leptalea Watson, Jour. Linn. Soc., 15, p. 261, 1880; Dall, Bull. M. C. Z., 9, p. 93, '81; Watson, Chall. Rept. Gastr., p. 441, pl. 27, f. 7, '85; Dall, Bull. M. C. Z., 18, p. 295, '89. (All as *Lunatia*).

Distribution.—Yucatan Strait, 640 fms. Also off Fernandina, Fla., and Sombrero Isl,, 450 fms,

fringilla Dall, Bull. M. C. Z., 9, p. 93, 1881; 18, p. 295, pl. 21, f. 12, '89; Bull. 37, U. S. N. M., p. 154, pl. 21, f. 12, '89. (All as *Lunatia*).

Distribution—Yucatan Strait, 640 fms. Also near Old Providence, 382 fms. *L. radiata* Watson, may be identical with this species.

hemicrypta Gabb, Jour. A. N. S. Phila.. (2), 4, p. 375, pl. 67, f. 5, 1860; (as *Natica*); Dall, Bull. 90, U. S. N. M., p. 106, pl. 9, f. 9, 1915.

eminuloides Gabb, Jour. A. N. S. Phila., (2), 8, p. 339, pl. 44, f. 4, 1875.

Distribution.—Upper Miocene, Galveston well at 2465-2733 feet, and of the Jennings-Heywood No. 29 well, Jennings, La., at 1960-1980 feet. Lower Miocene, Chipola marl, West Fla. Oligocene, Tampa silex beds.

Subgenus **NEVERITA** Risso

duplicata Say, Jour. A. N. S. Phila., 2, p. 247, 1822, (as *Natica*); Dall, Bull. 37, U. S. N. M., p. 154, pl. 51, f. 12, '89; Tr.

W. I. S., 3, p. 368, '92; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 105, 1915.

campechiensis Recluz, *fossata* Gould, *texasiana* Roemer.

Distribution.—Massachussetts to Mexico. Gulf coast: Cedar Keys, and many other localities, West Fla., Horn Island, Miss.; Point au Fer, Cameron, Chandeleurs, La.; Matagorda Bay and Galveston, Tex. Pleistocene, Grand Chenier, New Orleans well of 1856, New Orleans pumping station No. 7, Zigler, No. 15, Jennings, La., at 1350-1481 feet, Jennings-Heywood No. 30 well at 1127-1169, 1169-1277 feet, Knapp's wells, Terrebonne Parish, No. 2, at 1150-1200, 1330-1375, 1443-1618, 1700-1839 feet. Pliocene Gymnasium Club well at 1200 feet. Chesapeake Miocene, Maryland to Florida. Upper Miocene, Galveston well at 2158-2920 feet. Miocene, Crowley No. 25 well, Jennings, La., at 2468-2500 feet.

Subgenus **Payraudeautia** Bucq. Dautz. & Dollf.

nubila Dall, Bull. M. C. Z., 18, p. 294, 1889, (as *Neverita*); Dall and Simpson, Bull. U. S. Fish Com., 1. p. 439, pl. 58, f. 6, 1901.

Distribution.—Gulf of Mexico, Blake station 23, at 190 fms. Also off Barbados, 140 fms, and Porto Rico.

Subgenus **Mammilla** Schumacher

uberina d'Orbigny, Moll. Cubana, 2, p. 31, pl. 17, f. 19, 1842, (as *Natica*); Moerch, Malak. Blatt., 24, p. 60, 1877; Tryon, Man., 8, pl. 16, f. 57, '86; Dall and Simpson, Bull, U. S. Fish Com., 1, p. 439, 1901.

Distribution.—Gulf of Mexico, west coast of Florida, 14-40 fms., living. Also off Sombrero 54-70 fms. and Porto Rico.

lactea Guilding, Tr. Linn. Soc., 17, p. 29, '33; (as *Naticina*); Tryon, Man, 8, p. 49, pl. 16, f. 57, 58, '86; Dall, Bull. 37,

U. S.N. M,, p. 156, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 439, 1901.

Distribution.—Florida Keys to Porto Rico and Brazil. Also Texas region of the Gulf of Mexico. West Fla. (?).

brunnea Linck, Beschr. der Rostock Sammlung, 2, p. 140, 1807; Dall, Bull. 37, U. S. N. M., p. 156, '89.

mamillaris Lamarck, Anim. s. Vert., 6, pt. 2, p. 197, '22, (as *Natica*), Tryon, Man,, 8, p. 43, pl. 18, f. 74, '86; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 439, 1901.

Distribution.—Florida Keys to Trinidad Island and Texas region of the Gulf of Mexico.

Genus **SINUM** Bolten

prespectivum Say, Amer. Conch., p. 175, pl. 25, (as *Sigaretus*); Holmes, Post-Pl. Foss. S. Car., p. 81, pl. 12, f. 16, '60; Tryon, Man., 8, p. 57, pl. 24. f. 61, 64, '86; Dall, Bull. 37, U. S. N. M., p. 156, '89; Vanatta, Pr. A. N. S. Phila., 55, p. 758, 1903.

Distribution.—New York to Martinique. Gulf coast: Calhoun Co., Fla.; Chandeleurs, La.; Galveston, Mustang Isl. and Pass Cabello, Tex. Pleistocene, New Orleans pumping station No. 7, cited by Harris from Upper Miocene, Galveston well at 2252-2600 feet.

maculatum Say, Amer. Conch., p. 176, pl. 25, (as *Sigaretus*); Tryon, Man., 8, p. 56, pl. 24, f. 57, 58, '86; Dall, Bull. 37, U. S. N. M., p. 156, '89.

Distribution.—Hatteras to Guadeloupe and West Florida, shallow water. Closely related to *martinianum* Phillipi, (Abb. u Beschr. 1, p. 144, pl. 1, f. 5, 1844).

minor Dall, Bull. M. C. Z., 18, p. 297, '89, (as *Sigaretus*); Bull. 37, U. S. N. M., p. 156, '89.

Distribution.—West Florida, Florida Keys and Sombrero Isl., W. I. 54-84 fms.

Genus **EUNATICINA** Fischer

semisulcata Gray, Zool. Beechey's Voyage, p. 137, (as *Natica*); Tryon, Man., 8, p. 32, pl. 9, f. 74, '86;Dall, Bull. M. C. Z., 18, p. 296, '89; Tr. W. I. S., 3, p. 380, '92.

fordiana and *fordii* Simpson.

Distribution.—East Florida to Porto Rico. Gulf coast, Sarasota Bay, West Fla., between tides.

Genus **LAMELLARIA** Montagu

rangi Bergh, Mgr., p. 94, No. 8, '53; Dall, Bull. 37,U. S. N. M., p. 156, '89.

Distribution.—Texas region of the Gulf of Mexico. Apparently never figured.

Genus **MARSENINA** Gray

ampla Verrill, Pr. U. S. N. M., 3, p. 374, '80; Tr. Conn. Acad. Arts and Sci., 5, p. 518, pl. 42, f. 3, 3a, '82; Dall, Bull. 37, U. S. N. M., p. 156, '89; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 109, 1915.

Distribution.—Maine to Sarasota Bay, West Fla.

Genus **ACMAEA** Eschscholtz

candeana d'Orbigny, In de la Sagra's, Hist. Pol. y Nat. Isla de Cuba, 2, p. 199, pl. 25, f. 1-3, 1845, (as *Patella*); Dall, Bull. 37, U. S. N. M., p. 156, '89; Tryon, Man., 13, p. 38, '91; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 440, 1901.

Distribution.—Florida Strait to Tobago, W. I. Also West Florida and Texas.

punctulata Gmelin, Syst. Nat., 13, pp. 3705, 3717, 1792, (as *Patella*); Pilsbry, Tryon, Man., 13, p. 37, pl. 5, f. 11-13, 1891; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 440, 1901.

Distribution.—Key West, Florida to Porto Rico, Guadeloupe, and the Gulf of Mexico at Vera Cruz, Mex.

leucopleura Gmelin, Syst. Nat., 13, p. 3699, 1792, (as *Patella*); Pilsbry, Tryon, Man., 13, 7, 40, pl. 5, f. 16-21, '91; Dall & Simpson, Bull. U. S. Fish Com., 1, p. 440, 1901.

melanoleuca Dall, Bull. 37, U. S. N. M., p. 156, 1889. Not of Gmelin.

Genus **LEPETELLA** Verrill

tubicola Verrill and Smith, Amer. Jour. Sci., (3), 20, p. 396, '80; Verrill, Tr. Conn. Acad. Arts and Sci., 5, p. 534, pl. 58, f. 29, 29a, '82; Dall, Bull. M. C. Z., 18,p. 413, pl. 25, f. 6, '89; Bull. 37, U. S. N. M., p. 158, pl. 25, f. 6, '89; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 86, 1915.

Distribution.—Martha's Vineyard, Mass., at 130-388 fms., to Gulf of Mexico between Mississippi delta and Cedar Keys, at 324 fms.

Genus **PHASIANELLA** Lamarck

pulchella C. B. Adams, Proc. Bost. Soc. Nat. Hist., 2, p. 7, '45, (as *Turbo*); Tryon, Man., 10, p. 264, '88; Dall, Bull. M. C. Z., 18, p. 351, '89; Bull. 37, U. S. N. M., p. 158, 1889.

brevis C. B. Adams. Not of d'Orbigny, 1842.

Distribution.—Cedar Keys, Fla., to St. Thomas, W. I. Pliocene of South Carolina.

Genus **TURBO** Linnæus

castaneus Gmelin, Syst. Nat., p. 3595, 1792; Pilsbry, Man., 10, p. 203, pl. 45, f. 88-89, '88; Dall, Bull. 37, U. S. N. M., p. 158, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 441, 1901.

Distribution.—Cape Hatteras to Trinidad, W. I. Also West Florida in shallow water. 25-295 fms, Pliocene, Caloosahatchie and Shell Creek, Fla.

crenulatus Gmelin, Syst. Nat., p. 3575, 1788; Pilsbry, Man., 10, p. 203, pl. 45, f. 90, '88: Dall, Bull. 37, U. S N. M., p. 158, '89; Tr. W. I. S., 3. p. 382, '92.

Distribution.—Hatteras to Barbados. 2-30 fms. Also West Florida at Crooked Island and St. Andrew's Bay. Pliocene, of the Caloosahatchie, probably a variety cf *crenulatus*.

Genus **LEPTOTHYRA** (Carpenter) Pease

induta Watson, Jour. Linn. Soc., 14, p. 715, 1879 (as *Turbo*); Chall. Gastr. p. 128, pl. 6, f. 1, 1885.

albida Dall, Bull. M. C. Z., 18, p. 352, pl. 38, f. 6, '89.

Distribution.—Hatteras to Martinique, 15-2805 fms. Yucatan Strait, 640 fms.

Genus **LIVONA** Gray

pica Linnæus, Syst. Nat., 10, p. 763, 1758, (as *Turbo*); Pilsbry, Man., 11, p. 277, pl. 41, f. 24, '89; Dall, Bull. 37, U. S. N. M., p. 160, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 443, 1901.

Distribution.—Charlotte Harbor, West Florida, to Colon. 37-160 fms.

Genus **GAZA** Watson

superba Dall, Bull. M. C. Z., 9, p. 49, '81; 18, p. 354, pl. 22, f. 4, 4a, '89; Bull. 37, U. S. N. M., p. 160, pl. 22, f. 4, 4a, 1889.

Distribution.—Gulf of Mexico between Mississippi delta and Cedar Keys, 324 fms. Also Barbados.

fischeri Dall, Bull. Mus. Comp. Zool., Harv. Coll., 18, p. 355, pl. 37, f. 6, '89; Bull. 37, U. S. N. M., p. 160, pl. 37, f. 6, 1889.

Distribution.—Gulf of Mexico, west of Florida and St. Lucia, W. I., 423-426 fms.

(Callogaza) watsoni Dall, Bull. Mus. Comp. Zool., 9, p. 50, '81; 18, p. 356, pl. 22, f. 7, 7a, pl. 23, f. 1, 1a, pl. 24, f. 2, 2a. 1889.

Margarita filosa Dall, Bull, M. C. Z., 9, p. 42, '81.

Distribution.—Yucatan Strait, 640 fms. Also off Cuba and Barbados.

Genus **LIOTIA** Gray

gemmia Tuomey and Holmes, Pleioc. Fos. S. Carolina, p. 118, pl. 26,, f. 4, '56, (as *Trochus*);Dall and Simpson, Bull. U. S. Fish Com., 1, p. 445, 1901.

tricarinata Stearns, Proc. Bost. Soc. Nat. Hist., p. 23, for '72; (as *Architectonica*); Dall, Bull. M. C. Z., 18, p. 389, '89; Bull. 37, U. S. N. M., p. 166, '89.

Distribution.—Hatteras to Porto Rico. Also off Tampa, West Fla., 15 fms. Pliocene, Caloosahatchie beds.

bairdi Dall, Bull. M. C. Z., 18, p. 389, pl. 33, f. 8, '89.

Distribution—Gulf of Mexico, Blake Station 2, at 805 fms. Also off Carolina, Key West and Havana.

Genus **CALLIOSTOMA** Swainson

euglyptum A. Adams, Proc. Zool. Soc., p. 38, '54, (as *Zizyphinus*); Reeve, Mon. *Zizyp.*, pl. 3, f. 17, '63; Dall, Bull. M. C. Z., 18, p. 363, '89; Pilbry, Man., 11, p. 374, pl. 15, f. 37, pl. 57, f. 9, '89.

Distribution.—North Carolina to Florida, Texas and Vera Cruz, Mexico. Erroneously referred by Reeve to Tasmania. 3-32 fms. Pliocene ancestor is *C. philanthropus* Conrad.

circumcinctum Dall, Bull. M. C. Z., 9, p. 44, '81; 18, p. 364, pl. 22, f. 3, 3a, '89; Bull. 37, U. S. N. M., p. 162, pl. 22, f. 3, 3a, '89.

Distribution.—Florida Keys, Antilles and Yucatan Strait. 640-805 fms.

corbis Dall, Bull. Mus. Comp. Zool Harv. Coll., 18, p. 365, pl. 33, f. 1, '89; Bull. 37, U. S. N. M., p. 162, pl. 33, f. 1, 1889.

Distribution.—Gulf of Mexico, west of Florida, to Jamaica. 220-450 fms.

tiara Watson, Jour. Linn. Soc. 14, p. 696, '79; Rept. Chall. Gastr., p. 60, pl. 6, f. 4, '85, (as *Trochus*); Dall, Bull. 37, U. S. N. M., p. 162, '89.

Distribution.—Gulf of Mexico, Texas region, to Dominica, W. I. 220-780 fms.

roseolum Dall, Bull. Mus. Comp. Zool, Harv. Coll., 9, p. 45, '81; 18, p. 366, pl. 24, f. 6, 6a, '89; Bull. 37, U, S. N. M., p. 162, pl. 24, f. 6, 6a, '89.

Distribution.—North Carolina to Yucatan. Also Florida Straits and Havana. 21-200 fms.

pulcherum C. B. Adams, Contributions to Conch., No. 5, p. 69, '50; (as *Trochus*); Pilsbry, Man., 11, p. 375, '89; Dall, Bull. 37, U. S. N. M., p. 162, '89.

Distribution.—Hatteras to St. Thomas, W. I. Texas region Gulf of Mexico. 15-63 fms. Type locality, Jamaica.

veliei Pilsbry, The Nautilus, p. 128, 1900.

Distribution.—Caxambas Pass, Southwest Florida.

(Eutrochus) jujubinum Gmelin, Syst. Nat., p. 3570, 1792, (as *Trochus*); Pilsbry, Man., 11, p. 404, pl. 40, f. 16, '89; Dall, Bull. 37, U. S. N. M., p. 162, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 444, 1901.

Distribution.—Hatteras to Cartagena, Colombia. Gulf coast, West Florida, Texas and Yucatan. Pliocene, Caloosahatchie beds, Fla.

(Eutrochus) jujubinum var. **perspectivum** Koch, Philippi, Abbild. u.

Beschr. 1, pt. 2, *Trochus*, pl. 1, f. 5, 1843; Pilsbry, Man.. 11, p. 405, pl. 66, f. 35, 36, 89.

tampaensis Conrad, Pr. A. N. S. Phila., 3, p. 26, pl. 2, f. 35, '46; (as *Trochus*); Dall, Bull. 37, U. S. N. M., p. 162, '89.

Distribution.—Hatteras to Honduras. Also West Florida, shallow water.

(**Eutrochus**) **jujubinum** var. **rawsoni** Dall, Bull. M. C. Z., 18, p. 369, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 444, 1901.

Distribution.—Cedar Keys, Fla. and the Antilles.

(**Eutrochus**) **yucatecanum** Dall, Bull. M. C.Z., 9, p. 47, '81; 18, p. 370, pl. 24, f. 4, 4a, '89.

Distribution.—Yucatan Strait, 640 fms. Also off Carolina coast, 15-32 fms.

(**Dentistyla**) **asperrimum** Dall, Bull. Mus. Comp. Zool., 9, p. 40, '81, (as *Margarita*); 18, p. 373, '89; Pilsbry, Man., 11, p. 411, '89; Dall, Bull. 37, U. S. N. M., p. 162, '89.

Distribution.—Hatteras to Barbados. Also West Florida. 100-177 fms.

Genus SOLARIELLA S. Wood

amabilis Jeffreys, British Conch. 3, p. 300; 5, pl. 61, f. 6, (as *Trochus*); Dall, Bull. M. C. Z., 18, p, 378, '89; Pilsbry, Man., 11, p. 313, pl. 57, f. 52, '89.

Distribution.—Yucatan Strait, 640 fms. Also Antillean and European (North Sea off Shetland Isls, 85-95 fms).

scabriuscula Dall, Bull. M. C. Z., 9, p. 41, '81, (as *Margarita*); 18, p. 379, pl. 21, f. 10, 10a, '89; Bull. 37, U. S. N. M., p. 164, pl. 21, f. 10, 10a, '89.

Distribution.—Southern part of the Gulf of Mexico, 539 fms., bottom temperature 39° F. Also off Cuba.

aeglees Watson, Jour. Linn. Soc., 14, p. 704, '79; Chall. Rept. Gastr., p. 81, pl. 5, f. 10, '85; (as *Margarita*); Dall, Bull. M. C. Z., 9, p. 40, '81; 18, p. 379, '89; Pilsbry, Man., 11, p. 315, pl. 66, f. 18, 19, '89.

Distribution.—Gulf of Mexico, 287-888 fms. Also off St. Vincent, W. I.

aeglees var. **clavata** Watson, Jour. Linn. Soc. London., 14, p. 705, Chall. Rept. Gastr., p. 82, pl. 5, f. 8, (as *Margarita*); Dall, Bull. M. C. Z., 18, p. 380, '89; Pilsbry, Man., 11. p. 318, pl. 66, f. 98, 99, '89.

Distribution.—Yucatan Strait, 640 fms.; Culebra Isl., W. I. 350 fms.; Pernambuco, Brazil, 675 fms. Dall and Pilsbry regard this as a variety of *aeglees*.

lubrica Dall, Bull. M. C. Z., 9, p. 44, '81, (as *Margarita*); 18, p. 382, pl. 21, f. 9, '89; Pilsbry, Man., 11, p. 324, pl. 51, f. 25, 26, '89; Dall, Bull. 37, U. S. N. M., p. 164, pl. 21, f. 9, 9a, '89.

Distribution.—Cedar Keys, West Florida, to St. Lucia, W. I. 116-805 fms.

lubrica var. **iridea** Dall, Bull. M. C. Z., 18, p. 382, '89; Pilsbry, Man., 11, p. 324, '89; Dall, Bull. 37, U. S. N. M., p. 164, 1889.

Distribution.—Cape Florida, Gulf of Mexico, West Florida region. 193 fms.

lissoconcha Dall, Bull. M. C. Z., 9, p. 41, '81, (as *Margarita*); 18, p. 381. pl. 21, f. 8, 8a, '89; Bull. U. S. N. M., p. 164, pl. 21, f. 8, 8a, '89.

Distribution.—Gulf of Mexico, Lat 28° N., Lon. 88° W., at 331 fms.

Genus **BASILISSA** Watson

alta Watson, Jour. Linn. Soc. London, 14, p. 597, '79; Rept. Chall. Gastr., p. 100, pl. 7, f, 8, '86; Pilsbry, Man., 11, p.

419, pl. 36, f. 5, '89; Dall, Bull. 37, M. S. N. M., p. 164, 1889.

Distribution.—Gulf of Mexico, West of Cedar Keys; the Antilles and Brazil. 339-1019 fms.

alta var.**delicatula**Dall, Bull. M. C. Z., 9, p. 48, '81, (as *Seguenzia*); 18, p. 384, pl. 22, f. 2, '89; Pilsbry, Man., 11, p. 421, pl, 48. f. 3, 4, '89; Dall, Bull. 37, U. S. N. M., p. 164, pl. 22, f. 2, 2a, '89.

Distribution.—Gulf of Mexico to Tobago, W. I. 805 fms.

superba Watson, Jour. Linn. Soc. London, 14, p. 598, '79; Rept. Chall. Gartr., p. 101, pl. 7, f. 10, '86; Pilsbry, Man., 11, p. 424, pl. 36, f. 6, 7, '89; Dall, Bull. 37, U. S. N. M., p. 164, 1889.

Distribution.—Cape York, Australia, type locality. Also Gulf of Mexico west of Florida. 400-1400 fms.

(Ancistrobasis) costulata Watson, Jour. Linn. Soc. London, 14, p. 600, '89; Rept. Chall. Gastr., p. 103, pl. 7, f. 11, '86; Dall. Bull.,M. C. Z., 18, p. 384, pl. 23, f. 4, 4a, '89; Pilsbry, Man., 11, p. 426, pl. 36, f. 3, '89; Dall, Bull. 37, U. S.N. M., p. 164, pl. 23, f. 4, 4a, '89.

Distribution.—Georgia to Culebra, W. I.

costulata var. **depressa** Dall,Bull. M. C. Zool. Harv. Coll., 18, p· 384, '89: Pilsbry, Man., 11 p. 428, pl. 6, f. 14, 15, '89; Dall, Bull. U. S. N. M., p. 164, pl. 23. f. 4, 4a, '89.

Distribution.—Yucatan Strait, 640 fms. Also Antillean.

Genus **UMBONIUM** Link

bairdi Dall, Bull. Mus. Comp. Zool., Harv. Coll., p. 359, pl. 21, f. 6, 6a, '89; Pilsbry, Man., 11, p. 457, pl. 60, f. 5, 6, 1889.

Distribution.—Yucatan Strait, 640 fms. Also Florida reefs, 200 fms.

Genus **COCHLIOLEPIS** Stimpson

parasitica Stimpson, Proc. Bost. Soc. Nat. Hist., 6, p, 308, and fig., '58; Dall, Bull. M. C. Z., 18, p. 360, '89; Bull.37, U. S. N. M., p. 162, '89; Tr. W. I. Sci., 3, p. 418, '92.

Distribution.—Charleston Harbor, S. Car. to Florida Keys and Tampa, West Florida. At Charleston this species lives under the scales of a large annelid. Pliocene, Caloosahatchie beds, Fla., rare.

striata Stimpson, MS.; Dall, Bull. M. C. Z., 18, p. 360, 1889. Bull, 37, U. S. N. M., p. 162, '89; Tr. Wagner Inst. Sci., 3, p. 419, pl. 23, f. 16, 17, '92; Jacot, Jour. Mitchell Soc., p. 138, Feb., 1921.

Distribution.—Beaufort, N. Car. (Jacot); Egmont Key, near Tampa, West Fla. (Colonel Jewett). Upper Miocene of North Carolina.

Genus **ADEORBIS** S. V. Wood

adamsi Fischer, Journ. de Conch., p. 173, pl. 10, f. 11, 1875; Dall, Pr. U. S. N. M., 6. p. 335, '83; Bush, Tr. Conn. Acad. Sci., 10, p. 104, 1899-1900.

Distribution.—Cited by Dr. Dall from Cedar Keys, West Fla.

Genus **VITRINELLA** C. B. Adams

mooreana Vanatta, Proc. Acad. Nat. Sci. Phila., 55, p. 758, 1903.

Distribution.—Crooked Island, Calhoun Co., Fla.

hemphilli Vanatta, Proc. Acad. Nat. Sci. Phila., p. 24, pl. 2, f. 1, 3, 1913.

Distribution.—Cedar Keys, Florida.

interrupta C. B. Adams, Monograph of *Vitrinella*, p. 6, 1850; Journ. de Conch., 6, p. 176,; Dall, Bull. 37, U. S. N. M., p. 166, 1889; Bush, Tr. Conn. Acad. Sci., 10, pp. 106, 107, '99-1900.

Distribution.—Tampa, West Fla., in shallow water, to Jamaica.

Genus **CIRCULUS** Jeffreys

liratus Verrill, Tr. Conn. Acad. Sci., 5, p. 529, '82, (*Omalaxis*); 6, p. 452, '85, (*Skenea*); Bush. *op. cit.*, 6, p. 464, '85; Bull. M. C. Z., 23, p. 240, pl. 1, 11, 12, '93; Tr. Conn. Acad. Sci., 10, p. 125, pl. 23, f. 7, 12-12b, '99-1900.

Adeorbis supranitidus var. *orbignyi* Dall, Bull. M. C. Z., 18, p. 278, '89; (in part); Tr. W. I. S., 3, p. 344, '92; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 120, 1915; Not *orbignyi* Fischer, Journ. de Conch., 6, pp. 173, 286, '57.

Distribution.—New England to Hatteras and West Florida. Lower Miocene, Chipola beds, West Fla.

Note.—The true *Circulus orbignyi* Fisher is West Indian and very minute, only 1½ mm. in diameter, while *liratus* is 2½ mm. in diameter.

trilix Bush, Rept. U. S. Fish Com., for 1883, p. 584, 1885, (as *Skenea*); Tr. Conn. Acad. Sci., 10, p. 127, pl. 22, f. 6, 10, 10a, 12, a-g, pl. 23, f. 10, 15, 1899-1900.

Adeorbis supranitidus Dall, Bull. M. C. Z., 18, p. 278, '89; Bull. 37, U. S. N. M., p. 150, pl. 41, f. 7, 7a, '89, (in part). Not *supranitidus* Wood, Cat. 1842, Crag. Moll., p. 137, pl. 15, f. 5a-b, 1848.

Distribution.—Massachussetts to Hatteras and to Cedar Keys, West Fla. 15-25 fms. Pleistocene, Knapp's No. 2 well, Terrebonne Parish, La., at 1519-1632 feet.

Genus **LISSOSPIRA** Bush

proxima Tryon, Manual Conch., 10, p. 98, pl. 33, f. 4, 1888, (*Cyclostrema*); Bush, Tr. Conn. Acad. Sci., 10, p. 130, f. 4, pl 22, f. 3, 1899-1900.

rugulosum Verrill, Tr. Conn. Acad., 5, p. 533, '82, (*Cyclostrema*). Not of G. O. Sars, 1878.

affine Verrill, Tr. Conn. Acad., 6, p. 199, pl. 32, f. 15, '84, (as *Cyclostrema*). Not of Jeffreys, 1883.

trochoides Dall, Bull. M. C. Z., 18, p. 393, 1889; Dall, Bull. 37, U. S. N. M., p. 166, '89, (as *Cyclostrema*). Not *trochoides* (Jeffreys) Sars which is a variety of *petterseni* Friele.

Distribution.—Lat. 41° N., Lon. 65° W. to Lat. 35° N., Lon. 74° W. (Bush); West Florida (Dall).

Genus **CHORISTELLA** Bush

pompholyx Dall, Bull. M. C. Z., 18, p. 394, pl 28, f. 9, '89, (as *Cyclostrema*); Bull. 37, U. S. N. M., p. 166, pl. 28, f. 9, '89; Bush, Tr. Conn. Acad. Sci., 10, pp. 99, 140, 1899-1900.

Distribution.—Blake Station 2, Gulf of Mexico, type locality. Also Fernandina, Florida, to Cuba. 294-805 fms.
Note.—This species is referred tentatively to *Choristella* as Miss Bush suggested that it might prove referable to this genus.

Genus **EPICYNIA** Moerch

multicarinata Stimpson, MS., Dall, Bull. M. C. Z., 18, pp. 273, 392, '89; Bull. 37, U. S. N. M., p. 166, '89, (as *Vitrinella*); Bush, Tr. Conn. Acad., 10, p, 112, '99-1900.

Distribution.—Hatteras to West Florida. Pliocene, Caloosahatchie beds, Fla. Upper Miocene, Duplin Co., N. Car. Perhaps identical with the *Architectonica gemma* of Holmes listed by Hilgard from the Lake Borgne borings, La.

Genus **ETHALIA** A. Adams

The following species are of doubtful generic position. They were excluded from *Ethalia* by Pilsbry (Man. Conch., 11, p. 457) when he restricted that genus and gave *Ethalia guamensis* Quoy and Gaimard, as the genotype. Dr. Dall has referred me to Miss Bush's revision (Trans. Conn. Acad. Sci., 10, p. 116, '89-1900). Apparently she tentatively retains these three species in *Ethalia*.

suppressa Dall, Bull. Mus. Comp. Zool., 18, p. 362, '89; Bull. 37, U. S. N. M., p. 160, '89.

Distribution.—Goodland Point, West Florida. Collected by Hemphill.

reclusa Dall, Bull. Mus. Comp. Zool., 18, p. 361, pl. 28, f. 7, 8, '89; Bull. 37, U. S. N. M., p. 160, '89.

Distribution.—Yucatan Strait, 640 fms. North Carolina coast, 12-65 fms.

solida Dall, Bull. M. C. Z., Harv. Coll., 18, pl. 28, f. 3, 5, '89; Bull. 37, U. S. N. M., p. 160, pl. 28, f. 3, 5, '89.

Distribution.—West Florida and Cuba, 310 fms.

Genus **TEINOSTOMA** A. Adams

cryptospira Verrill, Trans. Connecticut Acad. Sci. and Arts., 6, p. 241, '84; (as *Rotella*); Dall, Bull. 37, U. S. N. M., p. 160, '89: Bush, Tr. Conn. Acad. Sci., 10, p. 118, f. 1, 2, 1899-1900; Dall, Tr. Wagner Inst. Sci., 3, p. 414, '92.

Distribution.—Hatteras to Florida. Gulf coast at Crooked Island, Calhoun Co., Fla. 30-150 fms. Pleistocene of North Creek, Fla. Miss Bush regards this species as a true *Teinostoma*.

Genus **NERITA** (Linnæus) Lamarck

peloronta Linnæus, Syst. Nat., 10, p. 778, 1758; Reeve, Conch. Icon., 9, pl. 2, f. 8, 8b, 1855; Tryon, Man., 10, p. 24, pl. 4, f. 75-77, 1888; Dall, Bull. 37, U. S. N. M., p. 166, 1889; Dall and Simpson, Bull. U. S. Fish. Com., 1, p. 445, 1901.

Distribution.—Florida, St. Vincent and Texas region of the Gulf of Mexico.

tessellata Gmelin, Syst. Nat., p. 3685, 1792; Reeve, Conch, Icon., 9, pl. 9, f. 43, 43a, 1855; Tryon, Man., 10, p. 24, pl.

4, f. 71, '88; Dall, Bull. 37, U. S. N. M., p. 166, '89; Dall, and Simpson, Bull. U. S. Fish Com., 1, p. 446, 1901,

Distribution.—East Florida to Colon. Gulf coast, West Florida and Texas, shallow water.

versicolor Lamarck, Anim. s. Vert., 6, pt. 2, p. 193, 1822; Reeve, Conch. Icon., 9, pl. 12, f. 56, a-d, 1855; Dall, Bull. 37, U. S. N. M., p. 166, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 446, 1901.

Distribution.—Florida Keys and West Florida to Colon, the Antilles and Bermuda.

Genus **NERITINA** Lamarck

reclivata Say, Jour. Acad. Nat. Sci. Phila., 2, p. 257, 1822, (as *Theodoxus*); Reeve, Conch. Iron., f. 34 a-b, '55; Dall, Pr. U. S. N. M., 8, p. 259, pl. 17, f. 8, '85; Tryon, Man., 10, p. 39, pl. 12, f. 25-27, '88; Singley, Fourth Ann. Rept. Texas Geol. Surv., p. 342, 1892; Mitchell, List. Texas Shells, p. 7.

Distribution.—St. Augustine to Martinique. Gulf coast: Mouth of Manatee River, Tampa, Cedar Keys and St. Mark's, Fla., Point au Fer and Chandeleurs, La.; Port Lavaca and Rockport, Tex. Pleistocene, Knapp's No. 3 well, Terrebonne Parish, La. from 1-700 feet.

Note.—The variety *palmae* Dall is found at Palma Sola, Texas.

virginea Linnæus, Syst. Nat., ed. X, p. 778, 1758, (as *Nerita*); Reeve, Conch, Icon., 9, pl. 21, f. 92, a-d, 1855; Dall, Pr. U. S N. M., 8, p. 259, '85; Tryon, Man., 10, p. 39, pl. 12, f. 31-35, 37-43; Dall, Bull. 37, U. S. N. M., p. 168, 1889; Singley, Fourth Ann, Rept. Geol. Surv. Texas, p. 342, 1892.

Distribution.—Florida to Brazil. Gulf coast: Various localities of West Florida; Corpus Christi and Rockport, Tex.

pupa Linnæus, Syst. Nat., ed. X, p. 378, 1758; Tryon, Man., 10, p. 42, pl. 14, f. 72, 73, '88; Dall, Bull. 37, U. S. N. M., p. 168, '89.

Distribution.—Charlotte Harbor, West Florida to Jamaica. Shallow water.

viridis Linnæus, Syst. Nat., ed. X, p. 778, 1758; Tryon, Man., 10, p. 54, pl. 18, f. 88, 1888; Dall, Bull. 37. U. S. N. M., p. 168. '89.

Distribution.—Florida Keys to Barbados, W. I. Also Texas region of the Gulf of Mexico.

showalteri Lea, Pr. Acad. Nat. Sci. Phila., p. 55, 1861; Tryon, Man., 10, p. 53, pl. 17, f. 81, 82, '88; Dall, Bull. 37, U. S. N. M., p. 168, '89.

Distribution.—Alabama and West Florida, Fluviatile.

sparsilineata Dall, Proc, U. S. N. M., 46, p. 236, 1914.

Neritina, sp. indet., Aldrich, Nautilus, 24, pt. 11, p. 131, No. 7, 1911: 26, pl. 1, f. 3, 4, 1912.

Distribution.—Upper Miocene or Pliocene. Well near Alexandria, La., at 49 feet; Pine Prairie La., well at 1540 ft. and well ½ mile S. E. of Pine Praire depot, in dump. Also Satilla River, Ga., and Burkeville, Texas. One of the most widespread and characteristic species of the brackish water formation, extending from Georgia through Louisiana to Texas.

Genus **PLEUROTOMARIA** Sowerby

(Petrotrochus) quoyana Fischer and Bernardi, Journ. de Conch., 5, p. 165, pl. 5, f. 1-3, 1856; Dall, Bull. M. C. Z., 9, p. 78, '81; Crosse, Journ. de Conch., 22, p. 14, '82; Dall, Bull. M. C. Z., 18, p. 397, pl. 29, f. 1, pl. 31, f. 1, 1b, 1c, pl. 37, f. 5, '89; Bull. 37, U. S. N. M., p. 168 same pls. and figs., 1889.

Distribution.—Yucatan, near Arrowsmith Bank, at 130 fms.

Also off Barbados, 73 fms., and Marie-Galante Island, near Guadeloupe.

Genus **FISSURELLA** Bruguiere

(**Cremides**) **barbadensis** Gmelin, Syst. Nat., p. 3729, 1792, (as *Patella*); Dall, Bull. 37, U.S. N. M., p. 170, '89; Pilsbry, Man., 12, p. 164, pl. 37, f. 40-49, '90; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 448, 1901.

Genus **LUCAPINA** Gray

suffusa Reeve, Conch, Icon., in *errata*, 1851, (as *Fissurella*); Dall, Trans, Wagner Inst. Sci., 3, p. 424, pl. 23, f. 22, '92.

hondurasensis Reeve, Conch. Icon., f. 70, 1851.

cancellata Sowerby, in part, Thesaurus Conch., p. 200, pl. 8, (243) f. 187 only, '62; Dall, Bull. 37, U. S. N. M., p. 170, '89; Pilsbry, Man., 12, p. 200, pl. 63, f. 1-3, pl. 37, f. 58, '90; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 449, 1901.

Distribution.—Marco, West Florida to Vera Cruz, Mexico. Also Antilles and South America to the Island of Fernando Noronha, Brazil.

Note.—As there has been some question whether the name *suffusa* Reeve or *cancellata* Sowerby should be applied to this species, Dr. Dall's opinion was asked. He replied, June, 1921, "I find nothing to change in the synonymy of *L. suffusa* as given in the Wagner memoir."

adspersa Philippi, Abbild. u. Beschr., 2, p. 34, pl. 1, f. 3, 1845; (as *Fissurella*); Pilsbry, Man., 12, p. 199, pl. 62, f. 6, 7, '90; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 449, 1901.

fasciata Pfeiffer. *Fissurellidea fasciata* (Pfeiffer) Dall, Bull. U. S. N. M., p. 172, '89.

Distribution.—West Florida region of the Gulf of Mexico to Cuba and St. Croix, W. I.

Genus **FISSURIDEA** Swainson

alternata Say, Jour. Acad. Nat. Sci. Phila., 2. p. 281, 1822, (as *Fissurella*); Pilsbry, Man., 12, p. 211; pl. 37, f. 50-53, pl. 61, f. 24, 25, '90; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 450, 1901.

Distribution.—Chesapeake Bay through the Antilles to Trinidad Isl. and Fernando Noronha, Brazil. Gulf coast: Cedar Keys, Fla.; Galveston, Corpus Christi, Texas; Vera Cruz and Progreso, Mexico. Also south of Nicaragua. 1-50 fms. Pliocene of South Carolina.

cayenensis Lamarck, Anim. s. Vert., 6, pt. 2, p. 12, 1822; Reeve, Conch. Icon., f. '82; Dall, Bull, 37, U. S. N. M., p. 170, '89; Pilsbry, Man., 12, p. 212, pl. 37, f. above 60, 1890.

Distribution.—Cedar Keys, Fla. to St. Lucia, W. I. Placed by Pilsbry in synonymy of *alternata*, but is more elongated and with straighter sides than that species. Perhaps to be classed as a variety.

Genus **PUNCTURELLA** Lowe

trifolium Dall, Bull. M. C. Z., 9, p. 76, '81; 18, p. 403, pl. 26, f. 8, 8b, '89; Bull. 37, U. S. M. N., p. 168, pl. 26, f. 8, 8b, 1889.

Distribution.—Yucatan Strait, 640 fms.

watsoni Dall, Bull. M. C. Z., 18, p. 403, '89; Bull. 37, U. S. N. M., p. 168, '89.

Distribution.—Off Yucatan, at 200 fms. Also off Cuba and Barbados.

circularis Dall, Bull, M. C. Z., 9, p. 75, '81; 18, p. 403, pl. 26, f. 7, 7b, '89; Bull. 37, M. S. N. M., p. 168, pl. 26, f. 7, 7b, '89.

Distribution.—Florida Strait and the West Indies.

(**Fissurisepta**) **triangulata** Dall, Bull. M. C. Z., 18, p. 404, '89; Bull. U. S. N. M., p. 170, '89.

rostrata Watson, Chall. Gastr., p. 48, pl. 4, f. 10, '85. Not of Seguenza.

Distribution.—Yucatan coast, 200 fms. Also off Fernandina, Fla., and Culebra Isl., W. I.

(**Cranopsis**) **asturiana** Fischer, Journ. de Conch., 30, p, 51, 1882, (as *Rimula*); Watson, Chall. Gastr., p. 45, pl. 4, f. 4, '85; Dall, Bull. M. C. Z., 18, p. 404, '89.

Distribution.—Yucatan Strait, 640 fms. Also off Havana, Martinique, and Cape Florida, and in the Gulf of Gascony at 2018 fms.

Genu **EMARGINULA** Lamarck

(**Rimula**) **frenulata** Dall, Bull. M. C. Z., 18, p. 406, pl. 28, f. 4, '89; Bull. 37, U. S. N. M., p. 170, pl. 28, f. 4, '89.

Distribution.—West Florida, Florida Keys and Hatteras, 6-52 fms.

(**Emarginula**) **compressa** Cantraine, Bull. Acad. Roy. Bruxelles, 9, p. 2. 1835; Jeffreys, Pr. Zool. Soc., p. 679, '83; Dall, Bull. M. C. Z., 18, p. 404, '89.

Distribution.—Yucatan Strait, 640 fms. Also off Havana, Barbados, and coast of Portugal. Tertiary of Sicily.

* * *

CLASS AMPHINEURA

ORDER POLYPLACOPHORA

Genus **LEPIDOPLEURUS** Risso

pergranatus Dall, Bull. M. C. Z., 18, p. 414, '89, (as *Leptochiton*); Bull. 37, U. S. N. M., p. 172, '89; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 451, pl. 58, f. 1, a-c, 1901.

Distribution.—Gulf of Mexico, western Florida region, Porto Rico and Dominica, 114-1181 fms.

Genus **CHAETOPLEURA** Shuttleworth

apiculata Say, Amer. Conch., app., pt. 7, 1830, (as *Chiton*); Dall, Bull. 37, U. S. N. M., p. 172, pl. 51, f. 10, 1889; Pilsbry, Man., 14, p. 35, pl. 13, f. 75-79, 1892; Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 8, 1915.

Distribution.—Massachussetts to Haiti, Gulf coast, various localities of northwestern Florida and Chandeleurs, La. 0-30 fms.

Genus **ISCHNOCHITON** Gray

limaciformis Sowerby, Proc. Zool. Soc., p. 26, '32, (as *Chiton*); Dall, Bull. M. C. Z., 18, p. 415, '89; Pilsbry, Man., 14, p. 57, pl. 16, f. 9-16, '92; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 452, 1901.

Distribution.—Gulf of Mexico, southeastern part, Lat. 24° N., Lon. 83° W., at 37 fms. Also Key West and the Antilles, Central America and Peru. Under stones at low water.

purpurascens C. B. Adams, Proc. Bost. Soc. Nat. Hist., p. 9, 1845, (as *Chiton*); Dall, Bull. 37, U. S. N. M., p. 172, '89; Pilsbry, Man., 14, p. 58, pl. 17, f. 23, 24, 1892; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 452, 1901.

Distribution.—Texas region of the Gulf of Mexico, Florida Keys, Jamaica and Porto Rico.

papillosus C. B. Adams, Proc. Bost. Soc. Nat. Hist., p. 9, 1845; Dall, Bull. 37, U. S. N. M., p. 172, '89; Pilsbry, Man., 14, p. 114, pl. 21, f, 40, 41, 1892; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 453, 1901.

Distribution.—Tampa, West Florida, to St. Thomas, W. I.

Genus **CHITON** Linnæus

tuberculatus Linnæus, Syst. Nat., ed. X, p. 667, 1758; Pilsbry, Man., 14, p. 153, pl. 33, f. 58-60, 1892; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 453, 1901.

Distribution.—Texas and Florida to Trinidad and Bermuda.

marmoratus Gmelin, Syst. Nat., p. 3205, 1792; Dall, Bull. 37, U. S. N. M., p. 172, '89; Pilsbry, Man., 14, p. 158, pl. 34, f. 72-76, 1892; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 454, 1901.

Distribution.—Texas, and the Antilles to Barbados. South to Cartagena, Colombia.

Genus **ACANTHOPLEURA** Guilding

granulata Gmelin, Syst. Nat., p, 3205, 1792, (as *Chiton*); Pilsbry, Man., 14, p. 227, pl. 50, 1892; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 454, 1901.

picea Gmelin, Dall, Bull. 37, U. S. N. M., p. 174, '89.

Distribution.—Charlotte Harbor, West Fla., to Trinidad, Bermuda and Bahamas.

Genus **ACANTHOCHITES** Risso

spiculosus Reeve, Conch. Icon., pl. 9, f. 47, 1847; Dall, Bull. 37, U. S. N. M., p. 174, '89; Pilsbry, Man., 15, p. 22, pl. 13, f. 60-62, 1893; Dall and Simpson, Bull. U. S. Fish Com., 1. p. 455, 1901.

Distribution.—Cedar Keys, West Florida, to Barbados.

pygmaeus Pilsbry, Tryon's Manual Conchology, 15, p. 23, pl 13, f. 58, 59, 1893.

Distribution.—Cedar Keys and Key West, Fla.

* * *

CLASS CEPHALOPODA

ORDER DIBRANCHIATA

Genus **ARGONAUTA** Linnæus

argo var. **americana** Dall, Bull. 37, U. S. N. M., pp, 174, 200, pl. 43, f. 1 a-b, pl. 64, f. 142b, pl. 67, f. 1-3, 1889; Johnson, Occ. Pa. Bost. Soc. Nat. Hist., 7, p. 223, 1915.

Distribution.—Massachussetts north to 43° N. Lat., and south to the Antilles and doubtfully to Brazil. Gulf of Mexico, West Florida region.

Note.—The typical *Argonauta argo* Linnæus, Syst. Nat., ed. X, p. 708, 1758, is Mediterannean. It has two or three times as many radial folds and carinal nodules as the variety *americana*.

Genus **SPIRULA** Lamarck

australis Lamarck, Anim. s. Vert. 7, p. 600, 1822; Encycl. Me'th., pl. 465, f. 5, a,b; Dall, Science, n. s., 3, pp. 243-245, 1896; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 359, pl. 56, f. 4, 1901.

spirula Linnæus, in part.

peroni (Lamarck) Dall, Bull. 37, U. S. N. M., p. 174, pl. 68, f. 4, '89.

Distribution.—Pelagic. West Indies and the Gulf of Mexico, shells being washed ashore along West Florida coast and at Cameron, La., Galveston and Corpus Christi, Texas. A specimen with all the soft parts was also taken from the mouth of a fish trawled by the Albatross between the Mississippi delta and Cedar Keys, at 324 fms. The *Spirula* had just been seized alive by the fish and the soft parts, previously imperfectly known, were complete. See Science, 1896.

There are several forms of *Spirula*. *S. spirula* of Linnæus was a composite, according to Dr. Dall, and since the species cannot be differentiated by the shells alone no one can tell exactly which species Linnæus had although he gave America as the habitat. Huxley and Pelseneer (Challenger Rept.) fixed the name *australis* Lamarck on the Antillean species.

Note.—*Argonauta* and *Spirula* are the only shell-bearing Cephalopods reported from the Gulf of Mexico. Of other forms, the Brazilian, *Loligo brevis* Blainville is cited from Cameron and elsewhere on the Louisiana coast, and *L. hemiptera* Howell from Florida and the Gulf of Mexico.

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The Miocene of Northern Costa Rica

WITH NOTES ON ITS GENERAL STRATIGRAPHIC RELATIONS

BY

A. A. OLSSON

Part I

(Pp. 1-168, April 21)

1922

Harris Co.
Cornell University, Ithaca, N. Y.
U. S. A.

DEDICATED

TO THE

MUSEUM OF COSTA RICA

THE MIOCENE OF NORTHERN COSTA RICA

WITH NOTES ON ITS GENERAL STRATIGRAPHIC RELATIONS

BY

A. A. OLSSON

I. Preliminary Remarks

II. General Stratigraphy of Northern Costa Rica

III. The Costa Rican Miocene

  A. The Uscari Stage

  B. The Gatun Stage

  C. The Uscari - Gatun Unconformity

IV. Correlation

  A. Santo Domingo Miocene

  B. Bowden Beds, Jamaica

  C. Mexican Miocene

  D. The East Coast Miocene

V. The Costa Rica Geosyncline

PRELIMINARY REMARKS

The fossil collections and field information, on which this monograph is based, resulted from over two years of field work by the writer in Panama and Costa Rica. The writer's thanks are due to the Costa Rica Oil Corporation for permission to publish; and he is most grateful for assistance, and encouragement received in the course of this work from Drs. A. C. Veatch and D. F. MacDonald of the Sinclair Exploration Company, to the Officials of the National Museum of Costa Rica and Professor J. Fidel Tristan of San Jose'.

The collections were studied in the Paleontogic Laboratory of Cornell University, the facilities of which, Professor G. D. Harris, most generously placed at my disposal.

Cornell University,
January, 1922. A. A. OLSSON

GENERAL STRATIGRAPHY OF NORTHERN COSTA RICA

The northern or Atlantic slope of Costa Rica, the so-called "Tierra Caliente" is largely composed of Tertiary sedimentary rocks, which except for some folding, dip away from the slopes of the Cordillera Central towards the sea. To the east, this sedimentary belt may be traced into the Province of Bocas del Toro of western Panama, where its upper and highly fossiliferous beds are well developed and exposed on the islands of the Chiriqui Lagoon. This Tertiary sedimentary belt ends some 35 to 40 miles east of the city of Bocas del Toro. The Miocene sedimentary rocks of Batun and of the northern Canal Zone form a small independent unit, which begins about 30 miles west of Colon and ends close to the eastern limits of the Canal Zone.

In a general way, the stratigraphic succession in northern Costa Rica is as follows:

Pleistocene	Slightly elevated coastal swamps, with deposits of cross-bedded sands, clay-marls etc.
Pliocene	Certain reef-limestones composed of coral and hydrozoa remains; also marls, blue lignitiferous clays, blue coarse sandstones, and a predominating hard conglomerate, composed of large boulders of igneous rocks (the so-called boulder-clays of several writers on Costa Rican Geology).
Miocene	The *Gatun Stage* or *Formation*. Coral-reef limestones, (near the coast), marls, more generally a blue or blue-black sandstone, dark colored shales, sandy and impure limestones, lignites and conglomerates. Generally very fossiliferous. The *Uscari Stage* or *Formation*. Usually dark-colored shales but with some sandstones, limestones and conglomerates. The smaller types of foraminfera are usually quite abundant, and are associated with fish-scales, and small echinoid spines, with mollusks generally rare.
Oligocene	Sandstones, shales and a complex of hard, often semicrystalline limestones which pass through all possible gradations to coarse arkosic sandstones. The most abundant and characteristic fossils are the Orbitoidal foraminifera (*Lepidocyclina*). The

age of these beds probably ranges from Lower to Upper Oligocene.

THE COSTA RICAN MIOCENE

An important part of the stratigraphic succession of northern Costa Rica is composed of rocks of Miocene age, whose thickness varies according to locality and completeness of section, from a few hundred to several thousands of feet. They are divisible into two stages or formations by an unconformity or disconformity of greater or less degree. In their natural order of sequence, these divisions of the Costa Rican Miocene are:

Gatun Stage or Formation: Middle and Upper Miocene
Uscari Stage or Formation: Lower Miocene

THE USCARI STAGE

The Uscari stage or formation derives its name from Uscari creek in the Talamanca valley of eastern Costa Rica. It consists principally of soft, dark-colored shales and because of their slight resistance to denundation, their outcrop frequently forms wide valleys and interior basins. These shales were deposited in quiet and moderately deep water, and their fauna is largely composed of the smaller types of foraminifera, such as *Globigerina*, *Textularia*, *Lagena*, *Nodosaria* and *Miliola*, but the large Orbitoidal *Lepidocyclinæ*, abundant in the underlying Oligocene, are absent. Mollusks are very uncommon in this formation. The small fauna described by Gabb from Sapote, Costa Rica, belongs to the lower part of the Uscari formation.

THE GATUN STAGE

The upper division of the Costa Rican Miocene is equivalent in part to the Gatun formation of the Canal Zone. The typical Gatun, so named from its well-known exposures at Gatun and in which a part of the Panama Canal and the locks at Gatun were excavated, lies in an independent sedimentary basin across the northern end of the Canal Zone and in the adjacent parts of the Province of Colon. There the Gatun formation consists of blue sandstones, dark-colored shales, fuller's earth beds etc., generally less than 500 feet thick. Many of its beds are very fossiliferous. The mollusks of the Gatun stage of Panama have been studied by Dall, Toula, Brown, Pilsbry and Cossmann.

In Costa Rica, the Gatun is very much thicker than in the Canal Zone and represents a longer depositional period. Paleontologically, the Gatun of the Canal Zone, seems to represent only the lower part of the formation as developed in Costa Rica. It is largely of sandy character, more resistant to denudation than the Uscari shales and gives rise to a more rugged and hilly topography. Although typically sandy, it also contains locally shales, lignites, conglomerates and coralline limestones. In some localities the limy members are of major importance. The formation is characterized by marked lateral variation in which respect it differs strongly from the much more uniform shales of the Uscari stage. This feature of lateral variation gives rise to two important phases: that of the more typical Gatun, in which the beds are largely sandy in character, with some lignitic and coarsely conglomeritic members, and carrying the usual near shore Gatun fauna; and the coralline phase, in which the beds are more marine, with coralline limestone and richly fossiliferous marls perdominating, and with no lignitic beds.

Along the inner margin of the Miocene belt, the Gatun belongs to the first and more typical phase; while the coralline type is more common along the coastal zone, as at Port Limon and Bocas del Toro. Coralline rocks may occur at any horizon in the Gatun succession or it may locally be composed of massive coral-reef limestones. Such is the case in the Limon Peninsula, and such coralline limestones, by most observers, have been regarded as of Pliocene or even of more recent age. At Limon, this confusion has partly arisen from the fact that these Miocene limestones are overlain by the second series, of Pliocene age, which partly yielded the large fauna described by Gabb, published shortly after his death in 1881. Dall later contributed to the discussion of this fauna. The truly Miocene limestones of Limon may be seen in good exposures along the sea-front west of the city. There they are massive in character, hard and recrystallized to the extent that all traces of organic remains have usually been obliterated or rendered uncertain of determination. However, some sandy or marly beds are occasionally found intercalated in these coralline limestones, and from these layers we have collected a large fauna of unquestionable Miocene affinities, correlating closely in age with the Bowden beds of Jamaica.

The fauna of the Costa Rican Gatun is largely molluscan. The following paleontological study records 334 species. Future collecting will doubtless greatly add to this list, as several species common it the Canal Zone, still remains undiscovered in Costa Rica. The smaller types of foraminifera abound in the more shaly phases of the formation, as well as several species of echinoids, belonging to the genera *Clypeaster* and *Encope*. Corals of simple and compound types occur principally in the coralline phase.

THE USCARI - GATUN UNCONFORMITY

At the close of Uscari time the Miocene sea was withdraw from the greater part of Costa Rica, but during the Gatun, it returned. These conditions are indicated by a stratigraphic break between the two stages, a complete change in their lithologic composition, the occurrence of Gatun beds in areas which had received no deposition during Uscari times and a change in their respective faunas. Although the full stratigraphic details of this important subject cannot be presented at the present time, attention is called to it, as the outstanding feature of the Miocene stratigraphy of Panama and Costa Rica; and because of its bearing on correlation.

In many parts of northern Costa Rica, the Gatun stage carries at its base a thick and persistent conglomerate, formed of coarse cobbles of igneous rocks. or of finer pebbles with alternating layers of sandstone. This conglomerate generally rests disconformably on the Uscari, but in some cases is unconformable on these or older rocks. This basal conglomerate is generally firmly cemented and because of its superior hardness, may become an important ridge former. It marks the site of high water-falls along many streams. Fossils of common Gatun types are abundant at many localities in this basal conglomerate.

Gatun rocks are frequently found in areas which contain no Uscari beds. In such cases, the Gatun is found resting, with strong unconformity, on older rocks. This condition is seen in the Canal Zone and along the borders of the sedimentary belt of the western Panama. It indicates, either a complete erosion of the Uscari shales during the Uscari-Gatun interval or, what is more likely, a greater transgression of the Gatun sea. This uncomformable relation of the Gatun upon older sedimentary beds may be seen in the Chagres Spillway in the Canal Zone, where the underlying rocks are sandstones, probably equivalent to the Mt. Lirio of Lower Oligocene age. In the Chiriqui Lagoon country, of western Panama, the base of the Gatun is frequently a coral-reef limestone, which rests directly upon the older and more disturbed rocks.

* * * * *

The present systematic study enumerates 334 species of molluska of which the majority belong to the Gatun stage. A few of these species have not been found in Costa Rica or western Panama, but are common in the Canal Zone, and are included here for the sake of comparison with Costa Rican species. To these we may add the 18 species described by Gabb from Sapote, Costa Rica, but not included in our collections and the following species listed below from the Canal Zone. This brings the total known Miocene fauna of Panama and Costa Rica to 396 species.

Volvulella micratracta Brown and Pilsbry
Ringicula hypograpta Brown and Pilsbry
Conus haytensis Sowerby
Conus domingensis Sowerby
Cruns consobrinus Sowerby
Conus æmulator Brown and Pilsbry
Drillia vaningeni Brown and Pilsbry
Drillia gatunensis Toula
Drillia fusinus Brown and Pilsbry
Drillia Zooki Brown and Pilsbry
Drillia enneacyma Brown and Pilsbry
Cythara heptagona Gagg
Marginella gatunensis Brown and Pilsbry
Anachis fugax Brown and Pilsbry
Murex polynematicus Brown and Pilsbry
Murex gatunsis Brown and Pilsbry
Typhis Gabbi Brown and Pilsbry
Malea camura Guppy
Cyprea Henekini Sowerby, var.
Bittium nugatorium Brown and Pilsbry
Natica bolus Brown and Pilsbry
Natica canalizonalis Brown and Pilsbry
Sigaretus gatunensis Toula
Sigaretus (*Eunaticina*) *Gabbi* Brown and Pilsbry
Cheilea princetonia Brown and Pilsbry
Nucula (*Acila*) *isthmica* Brown and Pilsbry
Pecten effosus Brown and Pilsbry
Pecten operculariformis Toula
Pecten reliquus Brown and Pilsbry
Amusium Toulæ Prown and Pilsbry
Ostrea gatunensis Brown and Pilsbry
Cardium durum Brown and Pilsbry
Cardium gatunensis Dall
Tellina æquiterminata Brown and Pilsbry
Corbula gatunensis Toula
Corbula sphenis Dall
Corbula sericea Dall
Solecurtus strigillatus Linné

Chione tegulum Brown and Pilsbry
Pitaria cora Brown and Pilsbry
Dosinia delicatissima Brown and Pilsbry
Petricola millestriata Brown and Pilsbry
Cyclinella gatunensis Dall
Thracia gatunensis Toula

The Uscari fauna is still poorly known, but it includes several very distinctive species of which the following are most important:

Amusinm Lyonii Gabb
Arca dariensis Brown and Pilsbry also Lower Gatun
Clementia dariena Conrad also Lower Gatun
Cancellaria (*Aphera*) *islacolonis* Maury
Neverita nereidis Maury
Sconsia cocleana Olsson
Scaphella costaricana Olsson
Ptychosalpinx ? dentalis Olsson
Dentalium uscarianum Olsson

The Gatun is the great fossil bearing formation of northern Costa Rica and Panama, and is characterized by a rich and highly diversified fauna. This fauna at the present numbers nearly 400 species, but additional collecting will doubtless add considerably to this number. As we have already noted the Gatun beds present two important facies, the sandy and highly clastic phase of the typical Gatun, and the deeper water type, illustrated by the coralline limestones and their associated marls. These lithological types have their own more or less peculiar and distinctive faunas.

The typical Gatun is the more common phase and is characterized by a molluscan fauna of heavy, thick-shelled species of littoral forms. In Costa Rica, the following are the most common and characteristic:

Arca MacDonaldi Dall
Arca Pittieri Dall
Pecten levicostatus Toula
Marginella MacDonaldi Dall
Voluta Alfaroi Dall
Strombus pugiloidis Guppy

Cardium stiriatum Brown, Pilsbry
Chione Rowelli Olsson
Chione mactropsis Conrad
Dosinia acetabulum Conrad
Conus molis Brown and Pilsbry
Stormbus gatunensis Toula
Natica Guppyana Toula
Turritella altilira Conrad and its varieties

The coralline phase is developed at several localities along the coast, most important of which are Port Limon and Bocas del Toro. Here the coralline limestones and associated marls form the greater part of the Gatun section, but coralline rocks may occur, interbedded with typical Gatun rocks, at any stratigraphical level.

These coralline limestones were formed, mainly as barrier reefs some little distance from the old Gatun shore-line. Naturally they offered very different habitat conditions from those of the typical near-shore and often lacustrine Gatun. Hence we find a fauna of deeper-water affinities with Pleurotomids and thin-shelled Cones, as the most important and characteristic element. In localities where these coralline rocks are exclusively developed, this fauna bears very little relation to the typical Gatun fauna , although the two are contemporaneous. The following are species of the coralline phase:

Pecten coralliphila Olsson
Antigona Harrisiana Olsson
Gafrarium limonensis Olsson
Large number of Pleurotomids
Conus planiliratus Sowerby
Conus limonensis Olsson
Conus stenostomus Sowerby
Turritella exoleta Linné var. *limonensis* Olsson
Mitra Alamagrensis var. *coralliphila* Olsson
Mitra poas Olsson
Marginella avena Valennencies
Olivella limonensis Olsson
Phos elegans, variety *limonensis* Olsson
Siliquaria modesta Dall, *limonensis* var. Olsson

About 13 per cent. of the Gatun fauna is identical or closely related to the recent species, the majority of which are found living along the present Caribbean coast, certain others only on the Pacific side in the Panama Province and a few common to both. This large percentage of recent forms corresponds closely with that characterizing the Chesapeake Miocene fauna of the eastern United States and shows their close agreement in age. The recent species and their closely related forms in the Gatun fauna are as follows:

Arca occidentalis Phil. West Indian
Arca umbonata Lamarck West Indian
Arca candida Gmelin West Indian
Arca auriculata Lamarck West Indian
Ostrea megodon Hanley Pacific
Anomia simplex d'Orb. West Indian
Phacoides radians Conrad var. *medioamericanus* Olsson West Indian
Phacoides trisulcatus Conrad West Indian
Glycymeris castaneus Lamarck West Indian
Glycymeris decussatus Linné West Indian
Divaricella quadrisulcata d'Orb. West Indian
Cardium medium Linné West Indian
Cardium spinosum var. *Turtoni* Dall East Atlantic
Cardium serratum Linné West Indian
Pitaria circinata Born and its var. *alternata* Broderip West Indian and Pacific
Antigona multicostata Sowerby Pacific
Antigona rugosa Gmelin West Indian and Pacific
Macrocallista maculata Linné West Indian
Chione grus Holmes West Indian
Tellina crystallina Chem. West Indian and Pacific
Strigilla pisiformis Linné West Indian
Mactra exoleta Gray Pacific
Mactra alata Spengler West Indian
Labiosa lineata Say West Indian
Corbula Dietziana C. B. Adams West Indian
Tellidora cristata Recluz West Indian
Conus proteus Hwass West Indian
Conus floridanus Gabb var. *costaricensis* Olsson West Indian
Terebra benthalis Dall var. *bocasensis* Olsson West Indian

Turris albida Perry West Indian
Glyphostoma dentifera Gabb West Indian
Acteocina bullata Kiener var. *costaricana* Olsson West Indian
Acteocina recta d'Orb. West Indian
Volvula cylindrica Gabb West Indian
Ancistrosyrinx elegans Dall variety West Indian
Marginella avena Valen West Indian
Murex messorius Sowerby West Indian
Bursa crassa Dillwyn West Indian
Natica canrena Linne West Indian
Architectonica granulata Lamarck West Indian nnd Pacific
Astralium brevispinum Lamarck, variety *basalis* Olsson West Indian
Astralium caelatum Gmelin West Indian
Sistrum nodulosum C. B. Adams West Indian
Latirus iufundibulum Gmelin West Indian
Northia northiæ variety *miocenica* Olsson Pacific
Crepidula plana Say West Indian
Xenophora conchyliophora Born West Indian
Oliva testicea Lamarck var. *costaricensis* Olsson

It is but natural to expect that the Miocene beds along the northern or Caribbean coast of Central America, should contain a fauna largely ancestral to that of the present Caribbean, but along with these strictly Caribbean types, we also find several species, identical or closely related to forms now resticted to the Pacific side. Their occurrence in Caribbean deposits points to a connection between the Atlantic and Pacific oceans during Miocend time and allows for a certain intermingling of their faunas. Geological observations indicate that there were at least two such straits crossing Central America during the Miocene, the main one across Costa Rica, and a second through the Darien of eastern Panama.

This Pacific element of the Gatun fauna comprises many of the most common and characteristic species. Certain of these species had a wide distribution in the West Indies during Miocene time and have been noted by several writers. They comprise the following species from Panama and Costa Rica, listed together with the Pacific analogues:

Panama or Costa Rica	Pacific Analogue
Arca Patricia Sowerby	*Arca grandis* Sowerby
Arca (*Noetia*) *MacDonaldi* Dall	*Arca reversa* Sowerby
Ostrea megodon Hanley	
Mactra exoleta Gray	
Mactra estrellana Olsson	*Mactra* (*Harvella*) *elegans* Sowerby
Semele laevis Sowerby var. *costaricensis* Olsson	*Semele laevis* Sowerby
Macoma panamensis Dall variety *canalis* Olsson	*Macoma panamensis* Dall
Macoma gatunensis Toula	*Macoma elongata* Hanley
Tellina crystallina Chemnitz	also West Indian
Antigona multicostata Sowerby	
Antigona rugosa Gmelin	also West Indian
Pitaria circinata Born variety *alternata* Broderip	
Cyclinella subquadrata Hanley variety *quitana* Olfson	*Cyclinella subquadrata* Hanley
Cyclinella beteyensis Olsson	*Cyclinella Kroyeri* Philippi
Conus recognitus Guppy	*Conus pyriformis Reeve*
Turricula lavinoides Olsson	*Turricula lavina* Dall
Cancellaria islacolonis Maury	*Cancellaria tesselata* Sowerby
Cancellaria toroensis Olsson	*Concellaria tuberculosa* Sowerby
Cancellaria Plummeri Olsson	*Cancellaria bullata* Sowerby
Mitra Swainsoni Brod. variety *limonensis* Olsson	*Mitra Swainsoni* Broderip
Neverita nereidis Maury	*Neverita glauca* Humbolt
Northia northiae Gray variety *miocenica* Olsson	*Northia narthiae* Gray
Malea camura Guppy	*Malea ringens* Swainson
Oliva testacea Lam. variety *costaricensis* Olsson	*Oliva testacea* Lam

With the closing of the Miocene straits, this Pacific element gradually had to give way before the development of the West Indian fauna, but it is still to be seen in such species as, *Tellina crystallina* Chem. *Architectonica granulata* Lamarck, which have a distribution along both coasts. Moreover the Pliocene and Pleistocene beds of Central America contain a well-marked Pacific element in such species as *Northia northiæ* Gray *Oliva testacea* Lamarck and *Pecten ventricosus* Sowerby.

CORRELATION

Miocene rocks are now known from a great many localities in the West Indies and the general Caribbean area of Central and South America. In these areas they comprise a very important series of sedimentary formations. Beds equivalent to the Gatun, appear to be the most widespread and generally are highly fossiliferous.

The following chart showing the equivalence of the Miocene horizons in the West Indies and elsewhere to those of Central America, does not differ materially from the more recent correlations proposed by Maury, Cooke or Vaughan, except in the addition of the Uscari to the Lower Miocene of Panama and Costa Rica. The Gatun formation is here recognized as being of Middle Miocene age with possibly some of its upper beds having Upper Miocene affinities. The Gatun, at its type locality in the Central Zone, is not more than 500 to 600 feet thick. In Costa Rica it is very much thicker, and its higher beds may range into the Upper Miocene. It is the exact equivalent of the Chesapeake Miocene of the eastern United States. In this correlation, I have been guided not only by the paleontologic evidence, but also by the field relations of the formations, studied over a wide rage of country in Costa Rica, and in Panama as far east as the Colombia frontier.

SANTO DOMINGO MIOCENE

In Santo Domingo and in Haiti, Miocene rocks are exposed in several areas, but attain their best development along the valley of the Rio Yaque del Norte in the northern part of the island. These beds are highly fossiliferous and because of the fine perservation of their fossils, have repeatedly attracted the attention of paleontologists.

The earlier writers dealing with the paleontology of the Dominican Miocene, believed that it represented but a single stratigraphic unit, and Gabb insisted that no division was possible. Dr. Maury however, as a result of paleontologic studies from collections carefully made in the field, was able to divide the Dominican Miocene into two formations, which she called the Gurabo and the Cercado. To these Vaughan and his associates, in more recent stratigraphic work on the island, have added 4 other subdivisions. The present recognized subdivisions of the Dominican Miocene are:

MIOCENE	MIDDLE	Mao clay Mao Adentro limestone Gurabo formation (*Sconsia laevigata* zone)
	LOWER	Cercado formation (*Aphera islacolonis* zone) Baitoa formation and Bulla conglomerate

The relation of the Costa Rican and Panama Miocene to that of Santo Domingo is extremely close; there being about 90 species in common. Of this number about 21 are recent, about 26 species appear to be restricted to the Gurabo, some 27 species are common to both the Gurabo and Cercado formations, and only 11 species are confined to the Cercado. The list of of Costa Rican and Panama species in the Dominican Miocene, is as follows:

Nucula tenuisculpta Gabb	Cercado and Gurabo
**Arca occidentalis* Phil	Cercado and Gurabo
**Arca umbonata* Lamarck	Cercado
Arca Mauryæ Olsson	Gurabo
Arca Henekeni Maury	Cercado
Arca golfoyaquensis Maury	Cercado and Gurabo
Arca chiriquiensis Gabb	Gurabo
**Arca auriculata* Lamarck	Gurabo

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*Recent

Glycymeris jamaicensis Dall Cercado
Limæa solida Dall Gurabo
*_Ostrea megodon_ Hanley Gurabo
Spondylus gumanomocon Brown and Pilsbry, Gurabo
*_Anomia simplex_ d'Orb Gurabo
Placunanomia lithobleta Dall Gurabo
Pteria inornata Gabb Cercado and Gurabo
*_Cardium serratum_ Linné Cercado and Gurabo
Cardium dominicensis Gabb
*_Cardium medium_ Linné Gurabo
Protocardia gurabica Maury Cercado
*_Mactra alata_ Spengler Cercado
Antigona tarquina Dall ? Cercado
Antigona Blandiana Guppy Gurabo
*_Pitaria circinata_ Born Cercado
*_Tellina crystallina_ Chemnitz Cercado
Tellina cercadica Maury Cercado
*_Strigilla pisiformis_ Linné Cercado
Semele Claytoni Maury Cercado
Venericardia scabricostata Guppy Cercado and Gurabo
Echinochama yaquensis Maury Gurabo
Corbula vieta Guppy Cercado and Gurabo
Corbula viminea Guppy Cercado
*_Acteocina recta_ d'Orb Cercado
Acteocina triticum-tritonis Maury Cercado and Gurabo
*_Volvula cylindrica_ Gabb Cercado
Bullaria paupercula Sowerby Cercado and Gurabo
Ringicula dominicana Maury Cercado
Terebra spirifera Dall Cercado
Terebra bipartita Sowerby Gurabo
Terebra haitensis Dall Gurabo
Terebra Berlineræ Maury Gurabo
Conus haytensis Sowerby Cercado and Gurabo
’’ _Sewalli_ Maury Gurabo

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*Recent

Conus stenostomus Sowerby Gurabo
Conus proteus Hwass Cercado and Gurabo
Conus recognitus Guppy Cercado and Gurabo
Conus multiliratus Bose Gurabo
Conus gracilissimus Guppy Cercado and Gurabo
Conus marginatus Sowerby Gurado
Conus consobrinus Sowerby Cercado and Gurabo
Conus domingensis Sowerby Gurabo
**Turris albida* Perry Cercado and Gurabo
Drillia venusta Sowerby Gurabo
Drillia consors Gurabo
Cythara heptagona Gabb Gurabo
**Glyphostoma dentifera* Gabb Gurabo
Cancellaria Mauryæ Olsson Cercado and Gurabo
Cancellaria Rowelli Dall
Cancellaria epistomifera Guppy Cercado and Gurabo
Cancellaria islacolonis Maury Cercado
Oliva brevispira Gabb Cercado and Gurabo
Oliva cylindrica Sowerby Cercado and Gurabo
Olivella muticoides Gabb Cercado and Gurabo
Mitra rudis Gabb Cercado and Gurabo
Mitra longa Gabb Cercado and Gurabo
**Latirus infundibulum* Gmelin Gurabo
Melongena consors Sowerby Cercado and Gurabo
Alectrion losquemadica Maury Gurabo
Metula cancellata Gabb Gurabo
Murex cornurectus Guppy Cercado and Gurabo
**Murex messorius* Sowerby Gurabo
Typhis alatus Sowerby Gurabo
Distortio simillima Sowerby Gurabo
**Bursa crassa* Dillwyn Gurabo
Cassis sulcifera Sowerby Cercado and Gurabo
Sconsia lævigata Sowerby Gurabo

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*Recent

Dolium camura Guppy	Gurabo
Dolium elliptica Pilsbry and Johnson	Gurabo
Cypraea Henekeni Sowerby	Cercado and Gurabo
Cypraea dominicensis Gabb	Gurabo
Strombus pugiloides Guppy	Gurabo
Serpulorbis papulosa Guppy	Cercado and Gurabo
Petaloconchus sculpturatus H.C.Lea	Cercado and Gurabo
**Architectonica granulata* Lamarck	Cercado
**Xenophora conchyliophora* Born	Gurabo
**Natica canrena* Linné	Cercado and Gurabo
Natica Youngi Maury	Cercado and Gurabo
Polinices subclausa Sowerby	Cercado and Gurabo
Polinices Stanislas-Meunieri Maury	Gurabo
Neritina viridemaris Maury	Corcado and Gurabo
Neverita nereidis Maury	Cercado

Most of the above listed species belong to the Gatun formation. *Cancellaria* (*Aphera*) *islacolonis* Maury, *Neverita nereidis* Maury and *Corbula viminea* Guppy occur in the Upper Uscari and in the Lower Gatun or transitional beds of eastern Costa Rica. This leaves but the following 8 Cercado species in the Gatun fauna, or a proportion of about 3.25 to 1.

Arca Henekeni Maury	Winter Cay
Glycymeris jamaicensis Dall	Winter Cay
Protocardia gurabica Maury	Water Cay and Gatun
Antigona tarquinia Dall ?	Saury
Tellina cercadica Maury	Saury
Semele Claytoni Maury	Hotel Creek
Corbula viminea Guppy	Middle Creek
Ringicula dominicana Maury	Middle Creek, Red Cliff Creek and Estrella River

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*Recent.

GENERAL CORRELATION CHART NO. I.

		Costa Rica and western Panama	**Canal Zone**	**Santo Domingo**	**Jamaica**	**Porto Rico**
		* * * * * *	* * * * *	* * * * * *	* * *	* * *
Pliocene	UPPER	Limon. Monkey Point, Bocas Conglomerates (boulder clays)		Las Matas Stage		
		* * * * * *	* * * * *	* * * * * *	* * *	* * *
MIOCENE	UPPER	Gatun Stage	? Toro Stage	Cerros de Sal Stage	Bowden Stage	Quebradillas l's.
	MIDDLE	Gatun Stage	Gatun Stage	Mao Clay Mao Adeotro limestone Gurabo Stage		
		* * * * * *	* * * * *	* * * * * *	* * *	* * *
	LOWER	Uscari Stage (Sapote)		Cercado Stage Baiton Stage		
		* * * * * *	* * * * *	* * * * * *	* * *	* * *
Oligocene		Undifferentiated	Emperado l's Culebra Stage Bohio congl.	Cevicos l's Tabera Stage		

GENERAL CORRELATION CHART NO. II.

Colombia and Venezuela	Mexico		Eastern United States		
* * * * * *		* * * * * *			* * * * * * * * * * *
					Caloosahatchie Waccamaw
* * * * * *		* * * * * *			* * * * * * * * * * *
Cartagena and Cumana	Contemporaneous	Txuetepec, State of Oaxaca Santa Rosa and Barranca de Santa Maria Tatetla, State of Vera Cruz	Chesapeake Series	Upper	Yorktown and Duplin Stage Murfreesboro Stage
				Lower	St. Mary's Stage Choptank Stage Calvert Stage
* * * * * *		* * * * * *			* * * * * * * * * * *
		Rio Coatzacoalcos, Isthmus of Tehuantepec	Alum Bluff Series and Stage		Shoal River marls Oak Grove marls Chipola marls
* * * * * *		* * * * * *			* * * * * * * * * * *
					Tampa Stage Vickburgs Stage

The _Arca Henekeni_, _Glycymeris jamaicensis_ and _Protocardia gurabica_ occur with a typical Gatun fauna at Water Cay, western Panama, associated with _Sconsia_, and other Gurabo shells. With the exception of _Ringicula dominicana_, the other species are generally rare. The evidence is therfore strongly in favor of the equivalence of the Gatun beds with the Gurabo of Santo Domingo.

BOWDEN BEDS, JAMAICA

Next to Santo Domingo, the highly fossiliferous beds at Bowden, Jamaica, are the best known. From this locality, Dall has listed about 435 species, of which 12 per cent. appear to be identical with recent species.

Recent correlation by Cooke places the Bowden beds as equivalent to the Gurabo formation of Santo Domingo, and therefore to the Gatun formation; a correlation which is borne out by our own studies. About 38 Gatun species, not including recent forms, are here considered equivalent to Bowden shells. In general, the Costa Rican localities which show the closest agreement with Bowden, are the upper coralline horizons, so that the Bowden beds may be a little higher than the main Gurabo and they are so considered here. The following Bowden shells occur in the Costa Rican Gatun.

*_Acteocina bullata_ Kiener
*_Acteocina recta_ d'Orb
*_Volvula cylindrica_ Gabb
Bullaria paupercula Sowerby
Terebra bipartita Sowerby
Conus planiliratus Sowerby
Conus stenostomus Sowerby
Conus granozonatus Guppy
Conus recognitus Guppy
Conus interstinctus Guppy
Conus gracilissimus Guppy
*_Turris albida_ Perry
Petaloconchus sculpturatus Lea
Alaba turrita Guppy
*_Crepidula plana_ Say
*_Nrtica_ near _canrena_ Linne
Glycymeris jamaicensis Dall
*_Arca occidentalis_ Philippi
*_Arca auriculata_ Lamarck
*_Ostera megodon_ Hanley
Limœa solida Dall
Placunanomia lithobleta Dall
Echinochama antiquata Dall

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*Recent

Drillia consors Sowerby
Drillia venusta Sowerby
Cancellaria Barretti Guppy
Oliva cylindrica Sowerby
**Latirus infundibulum* Gmelin
Melongena consors Sowerby
Metula cancellata Gabb
Typhis alatus Sowerby
Distortrix simillima Sowerby
**Bursa crassa* Dillwyn
Cassis sulcifera Sowerby
Sconsia sublævigata Guppy
Strombus pugiloides Guppy
Venericardia scabricostata Guppy
Myrtæa limoniana Dall
Phacoides actinus Dall
**Lævicardium serratum* Linne
Cytherea Blandiana Guppy
Tellina lepidota Dall
**Strigilla pisiformis* Linne
Abra triangulata Dall
Corbula viminea Guppy
Gastrochæna rotunda Dall
Phalium moniliferum Guppy
Malea camura Guppy
Serpulorbis papulosa Guppy

MEXICAN MIOCENE

From Mexico, Bose† has described several small faunas from the Isthmus of Tehuantepec, and from the States of Oaxaca and Vera Cruz. These faunas, he considered as Upper Miocene and Pliocene.

The most interesting of these localities, in the present connection, are those at Tuxtepec in the State of Oaxaca, and Santa Rosa and the Barranca de Santa Maria Tatetla in the State of Vera Cruz. From these localities, we may note together with their Costa Rican and other affinities, the following species:

Pecten santarosanus Bose	*Pecten levicostatus* Toula Gatun
Amusium Mortoni Ravenel	*Amusium luna* Brown and Pilsbry
Lævicardium sublineatum Conrad	Gatun Chesapeake Miocene
Anomia simplex d'Orb	Gatun-Chesapeake to recent
Venus Ebergenvii Bose	*Chione ulocyma* Dall Upper Chesapeake
Solarium Villarelloi Bose	*Architectonica granulata* Lamarck Lower Miocene or recent
Vermetus pulcher Bose	*Serpulorbis sculpturatus* H. C. Lea Gatun and Upper Chesapeake Miocene
Strombus pugilis Linne	*Strombus pugiloidis* Guppy Gatun
Sconsia sublævigata Guppy	Bowden
Phos mexicanus Bose	Gatun of Water Cay
Melongena Mengeana Dall	*Solenosteira Vaughani* Dall variety *medioamericana* Olsson, Gatun of Water Cay

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* Recent.

† Boletin del Instituto Geologico de Mexico, No. 22, 1919, pp. 11 - 88

Pleurotoma alesidota Dall var. *magma* Bose	*Drillia consors* Sowerby, Gatun
Conus Agassizi Dall variety *multiliratus* Bose	*Conus multiliratus* Bose, Gatun
Conus Burckharti Bose	Gatun

The above species are from Tuxtepec and Santa Rosa. To these we may add, from Barranca de Santa Maria Tatetla, the following forms:

Ostrea sculpturata Conrad	*Ostrea costaricensis* Olsson, Gatun
Lucina quadrisulcata Linné	*Divaricella quadrisulcata* d'Orb Gatun, Upper Chesapeake Miocene to recent
Lævicardium serratum Linné	Gatun, Upper Chesapeake to recent
Dosinia acetabulum Conrad	Gatun - Chesapeake Miocene

The above list is but a partial one of the entire fauna from these localities. However, it shows the close relationship between these Mexican species and those of the Gatun and the Bowden, such as *Sconsia sublævigata*, *Phos mexicanus*, *Conus multiliratus* and others, with a few typical Chesapeake species such as *Chione ulocyma* Dall, *Dosinia acetabulum* Conrad and *Cardium sublineatum* Conrad. This illustrates the intermingling of the Gatun-Bowden-Gurabo fauna with that of the Chesapeake, and proves their equivalence in age.

THE EAST COAST MIOCENE

A fine development of Miocene rocks is found along the Atlantic coastal plain and they extend more or less continuously from New Jersey south into Florida. They are continued around the borders of the Gulf of Mexico into Texas, but in these regions, their marine phases are deeply covered by younger formations, and they are known only from deep wells. These Miocene beds are divisible into two series, which early were classified as (a) the older or sub-tropical Miocene and (b) the younger and cold-water Miocene. These terms are descriptive of their main faunal differences. The upper division consisting of several formations or stages is frequently known as the Chesapeake Miocene or Chesapeake series, and the lower consisting solely of the Alum Bluff formation, may be designated for sake of discussion, the Alum Bluff series. These Miocene formations or stages are the following:

MIOCENE	Upper	Chesapeake Series	Yorktown, Duplin Stages Murfreesboro Stage	
	* * * *		* * * * * * * *	
	Middle		St. Mary's Stage Choptank Stage Calvert Stage	
	* * * *	* * * * *	* * * * * * * *	
	Lower	Alum Bluff Series	Alum Bluff Stage	Shoal River marl Oak Grove marl Chipola marl

This two-fold division is a very natural one. Each series represents a distinct trangression of the Miocene sea over parts of the Atlantic coastal plain, that of the Chesapeake being the more extensive. In Florida, where the Chesapeake Miocene is sometimes found resting upon the Alum Bluff beds, as at Alum and Jackson Bluffs, the contact is seen to be an erosional unconformity. At these localities, the Chesapeake Miocene is equivalent to the Murfreesboro stage or formation of Virginia and North Carolina, and hence the time interval represented by this break is equivalent to the Lower Chesapeake or the Marylandian Miocene. Dall,* who has paid special attention to the relations of the Alum Bluff and the Chesapeake series, both stratigraphically, and paleontologically, characterizes this break as "the most sudden, emphatic, distinct in the whole post-Cretaceous history of our southeastern Tertiary, and indicates physical changes in the surrounding region, if not in Florida itself, sufficient to alter the course of ocean currents and wholly change the temperature of the waters of our southern coasts."

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* Trans, Wagner Free Inst., 1903, p. 1594

The fauna of the Lower Miocene or Alum Bluff series is of warm-water character and largely composed of Antillean types. In the Chesapeake series, the fauna is of cold or temperate-water character and it finds its relations with the present Atlantic fauna north of Cape Hatteras. These faunal differences must be take into account in any correlation between the Miocene of the United States with that of the West Indies and Central America.

In the Correlation Charts, I have placed the Gatun formation as equivalent to the Chesapeake series, the Uscari formation with the Alum Bluff. The evidence upon which this correlation is based, may be summarized as follows:

1. The two-fold division of the Costa Rican and Panama Miocene, by an unconformity at the base of the Gatun formation.

2. Wherever the Gatun beds have been found overlain by more recent formations, the age of these overlying beds is Pliocene or younger.

3. The high percentage of recent species in the Gatun fauna, which agrees with the average as shown for the Cheapeake Miocene.

4. The Gatun fauna, contains a few species which appear identical with strictly Chesapeake species, such as the following:

Dosonia acetabulum Conrad
Petaloconchus sculpturatus H. C. Lea
Chama congregata Conrad
Plicatula marginata Say ?

The *Dosinia acetabulum* Conrad is one of the most abundant and characteristic species of the Chesapeake Miocene and in its course through the Chesapeake formations, several varieties are developed, of great use in correlation. The typical *acetabulum* is however confined to the Upper Chesapeake formations and it was figured by Conrad in his Medial Tertiary, from a fine large example from Smithfield, Virginia. It is characterized by its large size, broad outlines and even, concentric banding. This Upper Chesapeake or typical *acetabulum* corresponds very closely in size, form and sculpture to the Costa Rican examples. It is very common at certain localities in Costa Rica, especially in the lower part of the Gatun formation. Bose records it from Mexico. The *Petaloconchus sculpturatus* is a widely distributed species in the West Indies and Caribbean Miocene, from which it is more generally recorded as *P. dominigensis*, a name given to the Santo Domingian shell by Sowerby. Close comparative study of a large collection of typical *sculpturatus* from Virginia and North Carolina, failed to show any real difference, either in details or sculpture or in nature of coiling. The *Petaloconchus sculpturatus* occurs in the Bowden beds of Jamaica; the Gurabo formation of Santo Domingo; the Quebradillas limestone of Porto Rico; the Springvale beds of Trinidad; and the Gatun of Panama and Costa Rica. It is also known from Cumana, Venezuela: Cartagena, Colombia; and Santa Rosa, Mexico. In the Chesapeake Miocene, it is restricted to the Murfreesboro, Yorktown and Duplin formations, that is, to the Upper Chesapeake. It does not occur in the overlying Pliocene so far as is known.

5. Possibly more significant because of their greater number are the following species, which appear for the first time in the Atlantic coast Miocene in the Chesapeake formations. They also continue into the Pliocene and generally into the recent fauna.

Anomia simplex d'Orb	St. Mary's to recent
Cardium spinosum var. *Turtoni* Dall	Murfreesboro to recent
Cardium serratum Linné	Murfreesboro to recent
Cardium medium Linné	St. Mary's to recent
Labiosa lineata Say	Duplin to recent
Tellina umbra Dall	Duplin to recent
Chione grus Holmes	Duplin to recent
Phacoides radians Conrad	Duplin to recent
Phacoides trisulcatus Conrad	Chesapeake to recent
Divaricella quadrisulcata d'Orb	Murfreesboro to recent
Oliva sayana var. *immortua* Pilsbry and Brown	typical shell, upper Chesapeake to recent
Fasciolaria tulipa Linné	Pliocene

THE COSTA RICAN GEOSYNCLINE

The wide distribution of Miocene beds around the borders of the Gulf of Mexico and Caribbean sea, indicates a condition of general deposition during Miocene time. Costa Rica was largely under water, at least during the Lower Miocene, and was the locus of a strait or geosyncline that then connected the Atlantic and Pacific Oceans; while Panama, parts of Nicaragua, and other central American areas were mainly above sea level. This condition is shown in the general igneous character of the backbone of Panama, while in Costa Rica, sedimentary rocks of Miocene age occur even in the high interior and at elevations of several thousands of feet. This geosyncline covered the greater part of Costa Rica, a portion of western Panama, and western Nicaragua. It should be noted that this area, at the present time, is the locus of a large number of active volcanoes.

Certain changes of importance took place at the close of Uscari time, resulting in a brief withdrawal of the Miocene sea. The effects of these changes were widespread. These great land movements, which probably reached a culmination in the Pliocene, had far reaching consequences and to them we must ascribe even the sudden and marked change between the fauna of the Alum Bluff and Chesapeake series of the eastern United States. It probably resulted in a partial closing of the Atlantic-Pacific straits and a disarrangement of the direction of oceanic currents. The strongly clastic character of the Gatun formation as compared with the more shaly Uscari, is also a result of the elevation of the land.

The Pliocene was a period of high elevation and, in Costa Rica, of intense volcanic activity. The coarse conglomerates, or the so-called boulder clays, which have perplexed most geologists who have visited Costa Rica, were formed from the erosion of these Pliocene lava flows and deposited as flood-plain material. In a few localities where these conglomerates reached the sea, they contain intercalated shale beds carrying marine fossils of late Pliocene age.

MOLLUSCA

CLASS GASTROPODA

ORDER OPISTHOBRANCHIATA

SUBORDER TECTIBRANCHIATA

Genus **ACTAEON,** Montfort

Actæon costaricensis, n. sp.

Shell moderately large, ovate-cylindric; body-whorl large and more than ¾ of the total length of the shell; spire pointed, conic; whorls about 6, convex and with deep sutures; spiral sculpture of fine, nearly regular, smooth threads separated by deep and somewhat wider interspaces; there are about 9 spiral threads on the spire-whorls and about 34 on the last whorl; the interspaces are crossed by fine, elevated, distant threads; aperture linear-lanceolate, rounded below; columella with a single large fold.

Height 19.5 mm, diameter 10 mm, aperture 14. 5 mm.

This is an unusually large and cylindrical species with a relatively high spire. Suggestion of the original coloration is indicated by a white band which encircles the middle of the last whorl commencing at the upper end of the aperture,— the general ground-color of the surface being a faint purple or reddish brown. The interspaces between the spirals are crossed by fine, elevated threads, but they appear merely punctate on the early whorls.

Gatun Stage: Hill No. 3, Banana River.
Middle Creek.

Genus **ACTEOCINA,** Gray

Acteocina bullata Kiener, var. **costaricana,** n. var. Plate 15 figures 20, 21
cf. *Tornatina bullata* Kiener, Icon. Coq. Viv., p. 5, pl. 1, fig. 4.

Shell rather large, moderately solid; outlines subcylindrical but a little wider about the anterior half of the shell; the spire is short, composed of 4 or more whorls, and a small nucleus of the usual type, as in *canaliculata;* sutures channelled; the surface appears smooth, until slightly magnified when it is seen to be covered with very fine spiral lines; columella carries a single strong fold.

Height 10, diameter 3, aperture 9 mm.

The Costa Rican fossils are related to the recent *A. bullata* Kiener, of the West Indies but differ in their shorter spire and are somewhat more expanded about their anterior half. It is the largest species in the Costa Rican Miocene, often reaching a length of 10 mm. Its surface is covered with fine, spiral lines and the columella carries a single, strong plication.

Gatun Stage: Middle Creek.
Coll. 4, East Grape Point Creek.

Acteocina recta d'Orbigny

Bulla recta d'Orbigny, 1845, De las Sagra, Hist. Pol. y Nat. Isla de Cuba, vol. 5, p. 67, no. 55; Atlas 8, pl. 4, *bis*, figs. 16-20.

Tornatina recta Gabb, Trans. Phil. Soc., vol. 15, p. 246.

Tornatina coix-lacryma Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 22, p. 518. Probably not of Guppy, 1867.

Acteocina recta Maury, 1917, Bull. Amer. Pal., vol. 5, p. 178, pl. 3, fig. 3.

A small species, typically with a short exserted spire and a broadly cylindrical form. The Costa Rican examples are all less than 3 mm in height. There is considerable variation in the height of the spire, which may be sunken in some cases as illustrated by the larger *coix-lacryma* Guppy from the Miocene of Venezuela and Martinique, to others with high spires and strongly descending whorls as in the recent *canaliculata* Say. However they all appear to belong to the same species. From the young of *bullata* var. *costaricana*, they are at once distinguished by their smooth, plain surface.

Gatun Stage: Coll. 7, Estrella River.
Coll. 5, Red Cliff Creek.

Subgenus **CYLICHNELLA**, Gabb

Acteocina triticum-tritonis Maury

Cylichnella bidentata Gabb, 1873, (in part) Trans. Amer. Phil. Soc., vol. 15, p. 273. Not of d'Orbigny, 1845.

Cylichna bidentata Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 32, p. 518.

Acteocina (*Cylichnella*) *triticum-tritonis* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 178, pl. 3, fig. 4.

This shell was separated by Dr. Maury from the recent *bidentata* d'Orbigny, with which Gabb, Guppy and others had identified it. In *triticum-tritonis* the anterior of its plications is very small, the posterior one large, which is the reverse of the conditions as seen in the living *bidentata*. The base of the shell is finely grooved with incised, spiral lines. The specimens from Costa Rica agree very closely with typical specimens from the Miocene of Santo Domingo.

Gatun Stage: Middle Creek.

Genus **VOLVULA**, A. Adams

Volvula cylindrica Gabb

Volvula cylindrica Gabb, 1873, Trans. Amer. Phil. Soc.. vol. 15, p. 246.

Volvula cylindrica Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 32, p. 518.

cf. *Bulla* (*Volvula*) cf. *oxytata* Toula, 1908, Jahrb. der K-K. Geol. Reichsanstalt, Wien, vol. 58. p. 709, pl. 28, fig. 4.

Volvula cylindrica Maury, 1917, Bull. Amer. Pal., vol. 5, p. 180, pl. 3, fig. 5.

This, is a small species of no unusual characters. It is narrowly cylindrical in form, shortly produced and pointed at its posterior extremity. It was described by Gabb from the Miocene of Santo Domingo, but Dall united with it, the *oxytata* Bush, in which case, it is also found in the recent fauna. Gabb records *acuta* d'Orb. from the Pliocene of the Limon Peninsula.

Uscari Stage: Middle Creek.

Genus **BULLARIA**, Rafinesque

Bullaria paupercula Sowerby Plate 4, figure 14

Bulla paupercula Sowerby, 1849, Quart. Journ. Geol. Soc. London, vol. 6, p. 52.
Bulla paupercula Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 246.
Bulla paupercula Guppy, 1874, Geol. Mag. London, p. 437.
Bulla paupercula Guppy, 1876, Journ. Geol. Soc. London, vol. 32, p. 518.
Bulla paupercula Dall, 1890, Trans. Wagner Free Inst. Sci., vol. 3, pt. 1, p. 18.
Bulla striata Dall, 1903, Trans. Wagner Free Inst., Sci., vol. 3, pt. 6, p. 1583.
Bullaria paupercula Maury, 1917, Bull. Amer. Pal., vol. 5, p. 182, pl. 3. fig. 8.
Bullaria paupercula Maury, 1920, N. Y. Academy of Science, Tertiary Mollusca of Porto Rico., vol. 3, pt. 1, p. 75.

This species is rare in Costa Rica, and all our specimens are from the Lower Gatun rocks of Middle Creek. It is possibly identical with the recent *Bullaria amygdala* Dillwyn, abundant on the beaches along the northern coast of Panama and Costa Rica.

Gatun Stage: Middle Creek.

Genus **RINGICULA**, Deshayes

Ringicula dominicana Maury

Ringicula semistriata ? Gabb, 1875, Trans. Amer. Phil. Soc., vol. 15, p. 225. Not *R. semistriata* d'Orbigny.
Ringicula dominicana Maury, 1917, Bull. Amer. Pal., vol. 5, p. 185, pl. 3, fig. 11.

This is the most abundant of the Opisthobranch mollusks in the Miocene beds of Costa Rica. The whorls are in general more strongly sculptured with incised lines than typical *dominicana* from the Miocene of Santo Domingo, and the spiral lines extent over the greater part of the shell,except for a wide, smooth band about the suture.

The *R. hypograpta* Brown and Pilsbry,from Gatun is a larger shell with a heavier outer lip and more crowded spiral lines about the base. The Costa Rican shells measure about 1.5 mm or less in height.

Gatun Stage: Middle Creek. Coll. 5, Red Cliff Creek.
Coll. 7, Estrella River.

ORDER CTENOBRANCHIATA

(*A*) *SUPER-FAMILY TOXOGLOSSA*

GENUS **TEREBRA** ADANSON

Terebra subsulcifera Brown and Pilsbry

Terebra subsulcifera Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 339, pl. 22, fig. 7.

Terebra (*Myurella*) *subsulcifera* Cossmann, 1913, Jour. de Conchyliologie, vol. 61, p. 14, pl. 1, fig. 25.

The single, fragmentary specimen comes from the Gatun beds of Mt. Hope in the Canal Zone. From *bipartita*, which it resembles in its sculpture, this species and *haitensis* Dall, differ in having only a single columellar fold.

Gatun Stage: Mt. Hope, Canal Zone.

Terebra cf. **haitensis** Dall Plate 1, figure 3

Terebra haitensis Dall, 1895, Proc. U. S. Nat. Mus., vol. 18, p. 35.

Terebra haitensis Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1632, pl. 59, fig. 30.

Terebra haitensis Maury, 1917, Bull. Amer. Pal., vol. 5, p. 194. pl. 4, fig. 3.

The collection contains a single, imperfect shell from Sousci Creek, which should probably be referred to this species. From the *subsulcifera*, it differs in its more numerous and oblique ribs, and wider, less pronounced spiral bands. Like *subsulcifera*, the columella carries a single, sharp plication. Our specimen consisting of only 5 whorls measures 37 by 13 mm.

Gatun Stage: Sousci Creek, a branch of Hone Creek, C. R.

Terebra bipartita Sowerby Plate 1, figure 1, 2.

Terebra bipartita Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 47.

Terebra bipartita Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 225.

Terebra (*Acus*) *bipartita* Dall, 1895, Proc. U. S. Nat. Mus., vol. 18, p. 38.

Terebra bipartita Maury, 1917, Bull. Amer. Pal., vol. 5, p. 187, pl. 3 fig. 14.

This species, possessing much the same type of sculpture as *sulcifera*, *subsulcifera*, *haitensis* etc., is recognized by having two, instead of one columellar plication. Full-grown specimens have a bipartite sculpture while in *sulcifera* and the others it is tripartite.

The Costa Rican collection contains three specimens from Saury creek, near Cahuita, the largest of 10 incomplete whorls mearures 77 by 19 mm.

Gatun Stage: Zone E. Saury Creek

Terebra gatunensis Toula Plate 1, figures 4-6

Terebra gatunensis Toula, 1909, Jahrb. der K-K Geol. Reichsanstalt, vol. 58, p. 705, pl. 25, fig. 14.

Terebra gatunensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phil., vol. 63, p. 339, pl. 22, fig. 2.

Terebra wolfgangi Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phil., vol. 63, p. 340, pl. 22, figs. 1, 3-6, but not of Toula, 1908.

Terebra (*Myurella*) *gatunensis* Cossman, 1913, Jour. de Conchyliologie, vol. 61, p. 13, pl. 1, figs. 26-29.

In the Canal Zone, the Gatun beds contain two common species of *Terebra*, which were described by Toula as *gatunensis* and *wolfgangi*. These species have been more or less confused by Brown and Pilsbry, so that their figures and description of *wolfgangi*, really represent *gatunensis*. Their figure 2 is a large and less common variety of *gatunensis*. Toula's figure, although of a young imperfect shell, is clear and shows the main characters of the species, the spirally striated, faint sutural sulcus and fine spiral sculpturing of the whorls. He however in his notes, allies this species with the recent *T. dislocata* of Say, which is misleading. Toula's figure can be duplicated by scores of specimens in our collection.

Terebra gatunensis is characterized by its large size,(length 50 mm or more), its faint sutural sulcus which may be smooth or with 2 or 3 faint spirals, showing best on young shells. The spiral cords of the main body of the whorl are variable in number, spacing and strength, as well as the longitudinal ribs. A large coarse variety, with persistent sulcus, and heavier sculpture occurs rarely and is shown by Brown and Pilsbry as their figure 2. The pillar is nearly smooth, carrying a very broad fold above, and a small one below.

Gatun Stage: Gatun and Mt. Hope, C. Z.

Terebra wolfgangi Toula Plate 1, figure 11, 12

Terebra wolfgangi Toula 1909, Jahrb. der K-K Geol. Reichsandstalt, vol. 58, p. 705, pl. 28, fig. 7.

Not *Terebra wolfgangi* Brown and Pils. which is *T. gatunensis* Toula.

Although *T. gatunensis* and *wolfgangi* have not been collected by us except in the Canal Zone, where they are abundant, they are included here for the sake of completeness. It is also not unlikely that future collecting may still reveal their presence in the synchronous beds in Costa Rica and adjacent parts of Panama.

T. wolfgangi differs from the common *T. gatunensis* by its long, tapering form, deep, persistent sulcus and a sutural band generally free from spirals. It is also a much smaller species, the largest specimen in our collection measuring about 38 mm in length.

Gatun Stage; Mt. Hope, C. Z.

Terebra gausapata Brown and Pilsbry Plate 1, figures 8, 10

Terebra gausapata Brown and Pilsbry, April 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 340, pl. 22, figs. 8, 9.

Terebra acuaria Toula, Dec. 1911, Jahnb. der K-K Geol. Reichanstalt, vol. 61, p. 19, pl. 2, fig. 19.

Terebra (*Myurella*) *acuaria* Cossm., 1913, Journ. de Conchyliologie, vol. 61, p. 12, pl. 1, figs. 19-24.

The *T. gausapata*, was described by Brown and Pilsbry, from young specimens, measuring only 19 mm in length. Later in the same year appeared Toula's *T. acuaria*, also based on young shells.

The important characters of this species, are its nearly straight ribs, deep sulcus, a sutural band with faint spirals and even sculpture. Figures 23 and 24 of Cossmann I believe represents *wolfgangi*. *T. wolfgangi* as will be noted from the accompanying figures is a much more slender species and usually with a smooth sutural band. The pillar carries two broad folds, which are better developed than in *wolfgangi* or *gatunensis*.

Length 33, breadth 8.5 mm.

Gatun Stage: Mt. Hope, C. Z.
Water Cay.

Terebra spirifera Dall Plate 1, figure 13

Terebra dislocata Gabb, 1873, Trans. Amer. Phil. Sci., vol. 15, p. 225, Not of Say.

Terebra (*Acus*) *bipartita* Sowerby, variety *spirifera* Dall, 1895, Proc. U. S. Nat. Mus., vol. 18, p. 38.

Terebra (*Oxymeris*) *bipartita* Sowerby, variety *spirifera* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1632, pl. 59, fig. 13.

Terebra spirifera Maury, 1917, Bull, Amer. Pal., vol. 5, p. 188, pl. 3 figs. 15, 16.

In *T. Gatunensis* and *wolfgangi* the pillar is nearly smooth or with two board, sub-obsolete folds. In *spirifera*, the two folds are strong and recall those seen in the recent *T. dislocata*. The sutural band is strongly sculptured by the end of the ribs which are entirely dislocated by the deep sulcus. Typical specimens have three or four, even spirals, which are stronger than the longitudinal ribs. Variation occurs in the number, and regularity or these spirals,

Length 43, breadth 9 mm.

Gatun Stage: Banana River, Hill No. 1.
Water Cay.

Terebra spirifera Dall, variety **midiensis**, n. var. Plate 1 figure 7

This variety, represented only by a single specimen from Middle Creek, C. R., differs from typical *spirifera*, in having only three spirals, which are broad and strap-like in form.

Gatun Stage: Middle Creek. C. R.

Terebra Berlinerae Maury Plate 1, figures 17, 18

Terebra Berlineræ Maury, 1917, Bull. Amer. Pal., vol. 5, p. 198, pl. 4, figs. 7, 8.

This beautiful species was described by Dr. Maury, from the Cercado (Miocene) formation of Santo Domingo. The whorls are slightly convex, and its sculpture is closer, finer and more delicate than is seen in any of the associated Costa Rican Terebras. Our specimens, all imperfect, were collected from the hard Gatun sandstones of Boucary Creek. The most complete specimen measures 21 by 6.5 mm.

Gatun Stage: Boucary Creek.

Terebra estrellana, n. sp. Plate I, figures 9, 16

Shell small; nucleus of three smooth tapering whorls; post-nuclear whorls about 9, sculptured with a faint sutural sulcus, which is lacking or nearly so from the early whorls; axial sculpture of about eleven, straight or slightly oblique ribs which pass from suture to suture; but are nearly lacking from the base; spirals lacking or very faint on the spire-whorls, so that they appear smooth and solid; the base of the last whorl is strongly contracted and shows four or five, very faint spirals; pillar straight and smooth; beak twisted.

Length 7.5, diameter 2.5 mm.

This is a small species of rather solid appearance, strong ribs, but otherwise nearly smooth whorls. The spirals are very faint and are seen best only when viewed at right angles to the source of light. Our specimen came from the Estrella River.

Gatun Stage: Zone 7, Estrella River, C. R.

Terebra costaricensis, n. sp. Plate I, figure 19

Shell small and slender, with about three, long, tapering smooth, nuclear whorls; post-nuclear whorls eleven; sutural band rather large and prominent, strongly tuberculated; the spire-whorls are slightly concave and have at their base or just above the suture, a revolving series of tubercles, which are the enlarged bases of the longitudinal ribs; longitudinal ribs on the last whorl number about twelve, are nearly straight and large and strong on each side of the suture, low and weak in the middle of the whorls; the surface of the whorls are otherwise smooth or in some shells feebly spiralled; base slightly rounded with eight or more spirals which become finer as they approach the canal; the longitudinal ribs are continued across these spirals.

Length 13, diameter 3 mm.

The above description is based mainly on two specimens from Hill No. 3, of the Banana River. Our collection contains several smaller shells from Zone 7, of the Estrella River in which the base is somewhat more heavily sculptured and with very fine spirals over the main surface of the whorls.

Terebra benthalis Dall var. **bocasensis,** n. var. Plate 1, figures 25, 26

Cf. *Terebra* (*Acus*) *benthalis* Dall, 1889, Bull. Mus. Comp. Zool., vol. 18, p. 65, pl. 29, fig. 6.

This species, fairly abundant in the shale beds, just north of the city of Bocas del Toro, Panama, agrees closely with Dall's figure in the Blake Report, except that the revolving series of tubercles in the fossil shells seem to be lower and broader. The whole surface on slight magnification is seen to be finely spirally striated.

Terebra benthalis was described by Dall from specimens dredged from 100 to 400 fathoms of water off the Morro Light, Havana, Cuba. The species belongs to the section *Fusoterebra* Sacco.

Length 27, diameter 6.5 mm.

Gatun Stage: Bocas del Toro, Panama.

Terebra pumbriensis, n, sp. Plate 1, figure 27

Shell of medium size, composed of 9 whorls (type with a small portion of the apex lost); the early post-nuclear whorls (the 1st 3 or 4) with two revolving rows of tubercles, formed by the intersection of fine, oblique riblets and two spiral bands; on the 4th whorl of our specimen, a median spiral makes its appearance and rapidly increases in strength so that the later whorls have three rows of tubercles, the upper or most posterior one being somewhat the strongest; the longitudinal ribs are narrow and oblique, and on the last whorl number about 20; the space between the ribs have three or four fine, incised growth-lines; periphery of the base has an additional tuberculated spiral, below which is a band composed of four smooth, close spirals; between these spirals and the keel is a deep, concave zone; pillar nearly straight and smooth, with a single sharp keel on the back.

Length 20, diameter 4.75 mm.

Of this interesting and distinctive species, we have only a single, imperfect specimen from the Gatun beds of Pumbri Creek. The three rows of tubercles are evenly spaced and there is no sutural band.

Gatun Stage: Pumbri Creek, C. R.

Genus **CONUS** Linné

Conus molis Brown and Pilsbry Plate 2, figures 1, 2

Conus molis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 343, pl. 23, fig. 1.

Conus molis Maury, 1917, Bull. Amer. Pal., vol. 5, p. 200.

This is the common Cone in the Gatun beds of Panama and Costa Rica and large specimens may reach a length of nearly 150 mm. The upper surface of the whorls carry 5 or more fine spirals and perfect examples of young shells have a few of the early post-nuclear whorls finely coronated. Described by Brown and Pilsbry from the Canal Zone, the species has also been collected by us at several stations along the Panama coast between Colon and Bocas, at Water Cay, and along the Banana River in Costa Rica. A large specimen from Water Cay measures: length 144 mm, width 81 mm.

Gatun Stage: Gatun, Water Cay, Banana River, etc.

Conus stenostomus Sowerby Plate 3, figure 2

Conus stenostoma Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5 p. 44.

Conus stenostoma Guppy, 1866, *Id.*, vol. 22, p. 287, pl. 16, fig. 2.

Conus stenostoma Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 230.

Conus catenatus Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 527, in part b

Conus stenostomus Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1583.

Conus stenostomus Maury, 1917, Bull. Amer. Pal., vol. 5. p. 203, pl. 6, fig. 4.

A species characterized by its sharp angulated shoulder, concave upper surface of its whorls and attenuated anterior canal. Well-preserved examples showing a highly polished surface and traces of yellow blotches of color markings were collected quite abundantly in the coralline of Port Limon. The species also occurs in Jamaica and Santo Domingo.

Gatun Stage: Port Limon.

Conus concavitectum Brown and Pilsbry

Conus concavitectum Brown and Pilsbry, 1911. Proc. Acad. Nat. Sci. Phila., vol. 63, p. 341, pl. 23, figs. 5, 6.

Conus (*Lichoconus*) *concavitectum* Cossmann, 1813, Jour. de Conchyliologie, vol. 61, p. 43, pl. 4, figs. 3, 4.

In adult shells, the spire whorls become concave. The species is also recognized by its sharp shoulder and low spire. It may be confused with varieties of *proteus* but the sharp shoulder angle and spiralled spire whorls will separate it. Our specimens come from Water Cay, and measure 48 by 27 mm.

Gatun Stage: Canal Zone and Water Cay.

Conus proteus Hwass Plate 2, figures 3, 4

Conus proteus Hwass, 1789, Enc. Meth. vers, 1 pt. 2, p. 682.

Conus leoninus Hwass 1789, Enc. Meth. vers, 1 pt. 2, p. 683.

Conus proteus ? Gabb, 1873, Trans, Amer. Phil. Soc., vol. 15, p. 232.

? Conus Berghausii ? Gabb, *Idem*, p. 232. Not of Hoernes, Foss. Wien. Beck. pl. 1, fig. 3.

Conus leoninus Gabb, 1881, Jour. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 359.

Conus proteus Dall, 1890, Trans. Wagner Free Inst. Sci., vol. 3, pt. 1, p. 26.

Conus proteus Maury, 1917, Bull. Amer. Pal., vol. 5, p. 206, pl. 6, fig. 11.

This is a common species in the Miocene and Pliocene beds of Costa Rica and Panama. It is generally possible to distinguish two forms, a smaller one which agrees with typical examples of *proteus* in form and coloration (which is frequently preserved,) and a larger and heavier type, like the so-called *leoninus*. This second variety may show several dark spiral bands in addition to the square yellow blotches. Such markings we have not observed on recent examples of *leoninus*.

Gatun Stage: Banana River, Port Limon, Water Cay. Pliocene: Monkey Point; Bocas.

Conus Veatchi, n. sp. Plate 2, figures 5, 8

Shell rather large, heavy and broad, with a low, nearly flat spire, but pointed, slightly projecting apex; spire-whorls about 10 in number, with a slightly raised border near the suture and marked with fine spirals which on the last whorl number 10 or 11; shoulder of the last whorl rounded or beveled; last whorl, large and broad, nearly smooth above, except for the very faint spirals, but with numerous, fine, irregular spirals on the canal; pillar straight; aperture straight and narrow, slightly wider below.

Length 43, breadth 28 mm.

The present collection contains two specimens, the larger of which from Water Cay, serves as the *holotype*. The species is very unlike any of the associated Gatun species in its low, nearly flat spire. The *Conus demiurgus* Dall, of the Chipola Miocene of Florida, is a related species.

It is named for Dr. A. C. Veatch, Director of the Exploration Work of the Sinclair Consolidated Oil Corporation, for his interest and co-operation in obtaining the extensive collections which form the basis of the present work.

Gatun Stage: Water Cay, Panama.
Gatun, C. Z.

Conus floridanus, var. costaricensis, n. var. Plate 3, figures 3, 9

Shell conic, with a moderately high spire of about eleven whorls; profile of the spire flat or slightly concave to the long projecting apex seen in well-preserved specimens; shoulder angle rather sharp with the whorls slightly concave above between the sutures; spire-whorls generally show 3 or more faint, raised spirals and strongly arcuated growth lines; the last whorl below the shoulder angle is usually nearly smooth above (sometimes with faint spirals) but with heavy regular spiral groovings to the number of about fifteen on the canal; the canal is long, rapidly attenuated and usually somewhat flexed below.

Height 44, breadth 21 mm.

Type from the Gatun beds of the Banana River.

This fossil, quite common in Costa Rica, should probably be classed as a variety of the recent *Conus floridanus* Gabb, differing only in always being somewhat more slender. They also agree closely with Dall's figure of *Conus chipolanus* Dall from the Chipola Miocene of Florida.

Care should be taken in distinguishing this from *C. imitator* of the Canal Zone. In that species, the full-grown shell is larger, with nearly straight sides and finer irregular spirals on the canal.

Gatun Stage: Banana River; East Grape Point Creek.

Conus imitator Brown and Pilsbry Plate 2, figure 6

Conus imitator Brown and Pilsbry, April, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 342, pl. 23, fig. 4.

Conus Dalli Toula, Dec., 1911, Jahrb. der K-K Geol. Reichsanstalt, Wien, vol. 61, p. 508, pl. 31, figs. 23 a-d.

Conus (*Lithoconus*) *Dalli* Cossmann, 1913, Jour. de Conchyliologie, vol. 61. p. 41, pl. 3, figs. 30, 31, pl. 4, figs. 7, 8.

? *Conus Dall* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 212, pl. 7, fig. 15.

The *Conus Dalli* Toula is doubtless the young of *imitator* described earlier in the same year by Brown and Pilsbry. Figure 6 is of a specimen from Mt. Hope which measures 51 by 25 mm. From Costa Rica, the collection contains a series of perplexing Cones, which probably should be referred to this speces. From *costaricensis* they differ in their nearly straight sides, more irregular spiral groovings on the anterior canal, and they usually show faint spirals over most of the body-whorl, which I have not observed on *costaricensis*. A large shell from Zone C of Comadre Creek near Cahuita, measures 65 by 29 mm.

Gatun Stage: Mt. Hope and Gatun C. Z.
Water Cay, Panama.
Banana River, East Grape Point Creek,
Comadre, Middle Creek, C. R.

Conus recognitus Guppy Plate 2, figure 9

Conus solidus Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 6, p. 45, Not *C. solidus* Sowerby, 1841.

Conus solidus Guppy. 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 287. pl. 16, fig. 1.

Conus recognitus Guppy, 1867, Proc. Sci. Assoc. Trinided, p. 171, Harris Reprint, Bull. Amer. Pal., vol. 8, p. 198.

Conus pyriformis Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 229, Not of Reeve, 1843.

Conus recognitus Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 527.

Conus recognitus Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1583.

Conus recognitus Maury, 1917, Bull. Amer. Pal., vol. 5, p. 209, pl. 7, fig. 9.

This species is easily recognized by its well-rounded shoulder and appressed sutures. It is closely related to the recent *C.*

pyriformis Reeve of the west coast of Central America but the fossil shells have generally a lower and flatter spire. It is also known from the Miocene of Santo Domingo, Jamaica and Trinidad.

Gatun Stage: Banana River, Hill No. 3.

Conus limonensis, n. sp. Plate 3, figures 7, 8

Shell rather large, but delicate and rather slender; spire low, concave to the slightly projecting apex; spire whorls 10 or more, nearly flat between the sutures or slightly concave due to a slightly raised border; spire-whorls with 3 or 4 low spirals which become faint on the later whorls so that they are nearly smooth; sutures deep; shoulders of the last whorl angled or somewhat raised; body-whorl long and slender, polished and smooth, except for a few faint spirals near the tip of the canal; anterior canal long and straight, evenly tapering.

Length 41, breadth 24 mm.

This species is based on 2 specimens from the coral limestones of Port Limon, where it is associated with *Conus stenostomus* and *planiliratus*. From *stenostomus*, its straight canal, low spire and nearly smooth, polished surface is most noticeable.

Gatun Stage: Port Limon, C. R.

Conus musaensis, n. sp. Plate 1, figures 22, 24

Shell small and solid; spire short, conic, composed of about 2 pellucid, globular and projecting whorls and 6 post-nuclear whorls; the spire-whorls are flat or slightly cancave and project slightly over the anterior sutures; body-whorl with the upper half smooth, but with 12 deep grooves on the anterior canal which produce wide, spiral bands: these grooves are delicately incised by raised longitudinal lines; color markings are sometimes preserved, which appear as 8 narrow, gray bands on the upper half of the whorl.

Length 19, breadth 9 mm.

This small species, the Gatun analogue of the recent West

Indian *Conus Agassizi* Dall, is abundant along the Banana River and elsewhere in Costa Rica.

Gatun Stage: Banana River, Zone 6 Red Cliff Creek, C. R.

Conus cf. interstinctus Guppy Plate 3, figure 12

Conus interstinctus Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288, pl. 16, fig. 3.

A single specimen from Hill 1, of the Banana River, agrees closely with Guppy's figure of this Jamaican species. The shell measures 39 by 20 mm. The spire is moderate in height, with a slightly concave profile. The spire-whorls are smooth between the sutures but also show a slight coronation. The last whorl carries about 15 narrow, widely spaced, spiral cords which anteriorly are slightly beaded.

Dr. Maury unites *interstinctus*, with Sowerby's *catenatus*, but that species is based on a very young and scarcely distinguishable specimen. We therefore prefer to compare the Costa Rican shell with Guppy's larger and well-figured *interstinctus*.

Gatun Stage: Banana River, Hill No. 1.

Conus cf. Sewalli Maury

Conus Sewalli Maury, 1917, Bull. Amer. Pal., vol. 5, . 201, pl. 5, fig. 3, pl. 6, fig 3.

The collection contains 2 young shells which may belong to this Dominican species. They differ from the preceding *interstinctus* in being shorter and broader, and the spire-whorls in place of being smooth are marked with 5 or 6 strong spirals. The last whorl is sculptured with 15 or more widely spaced beaded spirals. The dimensions of the largest shell are: Length or height 30, breadth 19 mm:

Gatun Stage: Banana River.

Conus toroensis n. sp. Plate 2, figure 7

Shell of medium size, with a conic spire a little more than ½ the length of the aperture; the whorls of the spire numbering

12 plu/; are flat or slightly concave and bordered below by a low carina projectly slightly above the suture; this carina on all except the last whorl bears low nodes, about 20 to the later whorls; the spire-whorls are otherwise smooth except for the arcuate growth lines; the last whorl is a tapering cone, nearly smooth, except for the faint spirals about its lower one-third; the aperture is narrow, straight, with a thin arcuate outer lip.

Height 45, diameter 21, aperture 33 mm.

This shell belong to the *Conus consobrinus* group, agreeing in its form and strongly nodulated spire whorls. The main difference is that *toroensis* is nearly smooth, the spirals showing only on the lower one-third, while *consobrinus* has most of the last whorl covered with beaded spirls.

Gatun Stage: Toro Cays.

Conus (Chelyconus) tortuosostriatus Toula Plate 1, figure 15

Conus (*Chelyconus*) *tortuosostriatus* Toula, 1911, Jahrb. der K-K. Geol. Riechsandstalt, Wien, vol. 61, p. 508, pl. 31, fig. 22.

Conus (*Hemiconus*) *tortuosostriatus* Cossmann, 1913, Jour. de Conchyliologie, vol, 61, p. 40, pl. 3, figs. 28, 29.

Conus tortuosostriatus Maury, 1917, Bull. Amer. Pal., vol. 5, p. 205, pl. 6, fig. 9

This shell should probably be considered as a short variety of *gracilissimus* Guppy, differing chiefly in its broader form and shorter spire.

The body-whorl is sculptured with about 24 raised,even, spiral cords, separated by deep, even interspaces. These interspaces are crossed by neat, incised lines, corresponding to the lines of growth. The nucleus consists of about 3, long, tapering smooth whorls, after which follow several turns of carinated and finely coronated post-nuclear whorls.

Length 22, breadth 9 mm.

Gatun Stage: Bocas del Toro.

Conus granozonatus Guppy Plate 3, fig. 15

Conus granozonatus Guppy, 1866, Jour. Geol. Soc. London, vol. 22, p. 287, pl. 16, fig. 5.

This is a rare species in Costa Rica, our collection containing only a single specimen from the Gatun beds of the Rio Blanco. It is characterized by a rather high, conic spire, with smooth or only slightly coronated whorls. The last whorl has about 18, wide, spiral bands, which are heavily granulated above. The specimen agrees well with Guppy's figure of the Jamaican shell.

Length 25, breadth 11 mm.

Gatun Stage: Rio Blanco, C. R.

Conus planiliratus Sowerby Plate 3, figures 10, 13

Conus planiliratus Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 6, p. 44.

Conus planiliratus Guppy, 1866, *Idem.* vol. 22, p. 287, pl. 16, figure 7,

Conus planiliratus Gabb, 1873, Trans. Amer. Phil. Soc., p. 230, in part.

Conus planiliratus Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 528.

Conus planiliratus Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1583.

Couus planiliratus Cossmann, Jour. de Conchyliologie, vol. 61, p. 48, pl. 3, figs. 25, 26, 27.

Conus regularis Gabb, Jour. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 359, pl. 46, figs. 45-48. Not of Sowerby.

Conus planiliratus Maury, Bull. Amer. Pal., vol. 5, p. 209, pl. 7, fig. 10.

The occurrence of this species in Costa Rica is limited to the coral limestones of Limon, Gabb had specimens from here which he identified with the recent West Coast *Conus regularis* of Sowerby. The Limon shells agree very well with Guppy's figure in the Quarterly Journal and with Cossmann's figures of Bowden and Mindi specimens. The species appears to be closely related to the recent *Conus Stimpsoni* Dall from the Florida Straits. (Proc. U. S. Nat. Mus., vol. 24, p. 503, pl. 29, fig. 7, 1903).

Surface of whorls are heavily sculptured with 25, 30 or more subequal spiral cords. Upper surface of whorls, flat or slightly concave and with 3 or more spirals. The shoulder is sharp and bounds a rather high, conic spire.

Length 31, breadth 16 mm.

Gatun Stage: Port Limon.

Conus planiliratus, var. **bocasensis**, n. var. Plate 3, fig. 14, 16

Shell of medium size, solid with a broad, stubby outline; spire low, conic with nearly straight sides and composed of seven or more whorls; the 1st 4 or 5 post-nuclear whorls are coronated; spire-whorls with 3 faint spirals and curved growth-lines; body-whorl large and wide, with 25 strong but somewhat irregular simple spiral cords; their interspaces are wide and with crowded, raised lines of growth and sometimes intercalated spirals; anterior canal nearly straight.

Length 32, breadth 17 mm.

This Cone, which should probably be considered as distinct, is fairly common in the shale beds, belonging to the Gatun Stage on Bocas Island. From typical *planiliratus* it differs in its broad stubby form and coarse sculpturing.

Gatun Stage: Bocas del Toro, Panama.

Conus marginatus Sowerby Plate 1, fig. 20

Conus marginatus Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 6, p. 44.

Canus marginatus Gabb, 1873, Trans. Amer. Phil. Soc., vol. 16, p. 230.

Conus marginatus Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 528, pl. 29, fig. 5.

Conus marginatus Maury, 1917, Bull. Amer. Pal., vol. 5, p. 210, pl. 7, fig. 11.

On the basis of Guppy's figure in the Quarterly Journal, this cone is seen to belong to the type exemplified by the recent *C. verrucosus*, with its sulcated sides and appressed or beveled shoulder angle. Our collection contains a single specimen from Zone 5 of Red Cliff Creek which is very close to Guppy's figure. Cossmann's specimen of *marginatus* from Martinique should probably be referred to some other species.

Gatun Stage: Zone 5, Red Cliff Creek, C. R.

Conus gracilissimus Guppy Plate 1, figure 14

Conus gracilissimus Guppy, 1866, Quart, Jour. Geol. Soc. London, vol. 22, p. 288, pl. 16, fig. 4.

Conus Orbignyi Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 230, Not *C. Orbignyi* Audouin, 1830.

Conus gracilissimus Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 527.

Conus gracilissimus Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1583.

Conus gracilissimus Cossmann, 1913, Jour. de Conchyliologie, vol. 61, pl. 4, fig. 13.

Conus gracilissimus Maury, 1917, Bull. Amer. Pal., vol. 5, p. 204, pl. 6, figs. 8.

A small, but long and slender cone, sulcated with 25 or more, strong, regular spiral cords. The spire is long and slender with slightly coronated whorls and the area between the sutures is delicately decussated by 3 or more spirals crossed by the raised and arcuated lines of growth.

Our collection contains specimens from Bocas and Limon, the largest measuring 26 by 9 mm.

Gatun Stage: Bocas del Toro, Pan., Port Limon, C. R.

Conus Burckhardti Bose Plate 3, figures 4, 5

Conus Burckhardti Bose, 1906, Bull. de Inst. Geol. de Mexico, numero 22, p. 50, pl. 5, figs. 39, 40.

Shell of moderate size, with a rather high slightly concave spire and long, acute apex; sutural whorls smooth, except for the faint arcuate lines of growth and very indistinct spirals; the earlier whorls have a carinated suture but are only very faintly coronated; last whorl heavily sculptured with about 20, wide, even spiral bands, separated by grooves of about 1-3 of their width; these grooves are faintly incised by the longitudinal lines of growth; the spiral bands are slightly wider above and smooth, becoming granulated on the canal; this granulation appears on the posterior side of the bands only; aperture long and narrow.

Length 36, diameter 14.5 mm.
33 (apex broken) diameter 15 mm.

The original specimen of *Conus Burckhardti* was described from the Miocene of Mexico, State of Oaxaca. Our specimens from Panama and Costa Rica are a little larger, but show the characteristic high, smooth, spire and strong, flat, spiral bands of the body-whorl.

Conus tortuosopunctatus Toula is a similiar but smaller species. The difference in sculpture of the two species may be seen in the accompanying figures, the spiral bands of *tortuosopunctatus* being double or incised, while in *Burckhardti*, they are broad and simple.

Gatun Stage: Water Cay, Panama.
Zone 2, East Grape Point Creek.

Conus Harrisi, n. sp. Plate 3, fig. 1

Shell of moderate size, subcylindric with a high, even, conic spire; spire-whorls about 6 plus, flat, with close sutures, except for the upper whorls which are slightly carinate; the surface of the spire-whorls is nearly smooth, except for a few faint spirals; the last or body whorl is strongly sculptured with widely spaced and sub-regular grooves; these grooves form about 14 wide, spiral bands about the lower 3-4th of the last whorl; the upper 4th below the shoulder angle forms a wide, smooth band; below, the spiral bands are generally smooth except those about the lower half of the shell, which may become, mesially divided and bear a few small granulations or beads about their upper half; aperture sublinear.

Height 51, diameter 23 mm.

A single specimen of this elegant species was collected from the Gatun of the Banana River. It is a species of the *Conus Burckhardti* type but much larger and when perfect reaching a length of nearly 60 mm. The sculpture is of wide bands formed by deep, and regularly spaced grooves about the lower 3-4ths of the shell.

Gatun Stage: Hill No. 3, Banana River.

Conus multistriatus Bose Plate 1, figures 21, 23

Conus Agassizi Dall, variey *multistriatus* Bose, 1906, Bull. de Inst. Geol. de Mexico, numero 22, p. 49, pl. 5, figs. 34-38.

Conus gaza Johnson and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, pl. 23, figs. 2, 3.

Conus gaza Maury, 1917, Bull. Amer. Pal., vol. 5, p. 210, pl. 7 fig. 12.

This is the *Conus gaza* of Johnson and Pilsbry described from the Miocene of Santo Domingo and the Isthmus. It is a small, pretty species, recognized by its nearly biconic outlines and neat sculpture. The spire is high; with nearly smooth, spire-whorls and carinated sutures. The last whorl is rather short and heavily sulcated with about 18, regular, spiral cords, separated by intervals of their own width.

All our specimens come from Water Cay, where the species is fairly abundant. The largest specimen measures 20 by 11 mm. Bose's original specimens are from the Miocene of the State of Oaxaca, Mexico. They are somewhat larger, measuring 28 by 15 mm.

Gatun Stage: Water Cay.

Conus tortuosopunctatus Toula Plate 3, figures 6, 11

Conus tortuosopunctatus Toula, 1911, Jahrb. der K-K. Geol. Reichsanstalt, Wien, vol. 61, p. 507, pl. 31, fig. 21.

Shell small, with a high smooth, conic spire of about 12 whorls the earlier post-nuclear whorls are finely nodulated, the succeeding have the sutures carinated and then simple; body-whorl with 20 or more strong, beaded, spiral cords; three spiral cords are usually double or incised with a median line, especially on the anterior canal; the beading of the spiral cords is developed best on their posterior portions; interspaces of the cords nearly as wide as the cords themselves, smooth or with faint, longitudinal lines and frequently a small median spiral.

Length 30, breadth 13 mm.

Gatun Stage: Mt. Hope.

FAMILY TURRITIDÆ

Genus **TURRICULA** Schumacher

SECTION SURCULA H. AND A. ADAMS

Turricula lavinoides, n. sp. Plate 4, figure 6

Shell rather large and moderately solid; whorls about 12 in number, heavily sculptured with ribs and spiral cords; nucleus of two smooth, slightly bulbous whorls; post-nuclear whorls increasing uniformily in size; concave above, widest below the periphery; suture strongly appressed with a spiral cord in front of it; anal fasciole flat or concave, appearing nearly smooth except for about three, small, widely spaced spirals; remainder of whorls strongly sculptured with 8 or 12 axial ribs which are lacking from the anal fasciole and from the base of the last whorl; spiral sculpture of 3 or 4 strong cords on the spire-whorls, becoming 10 or more on the last whorl in addition to those of the anterior canal; finer, intercalated threads are present between the main spiral cords on the later whorls; the interval between the spirals is finely, longitudinally striated by long growth lines; anterior canal long and nearly straight, slightly calloused along the inner lip; outer lip thin, with a shallow anal sinus, lying in the sutural fasciole.

Length 54, diameter 20, last whorl 38 mm.

This elegant species may be compared with the *T. jaquensis* Sowerby from the Santo Dominican Miocene and the recent *T. lavinia* Dall from the West Coast of Mexico. The Dominican species lacks the sutural cord, as well as differing in details of its sculpture. *T. lavinia*, appears to be more closely related, differing in its finer sculpture and proportions.

Gatun Stage: Hill 1a, Banana River.

Turricula lavinoides var. **limonensis**, n. var. Plate 4, figure 12

Shell of medium size and with about 10 whorls; nuclear whorls about 2 in number, at first smooth, becoming finely ribbed on the last half; post-nuclear whorls spirally and axially sculptured; anal fasciole concave, smooth, with a strong spiral cord, just in front of the appressed suture; axial sculpture of about 8 sharp or pointed ribs on the periphery of each whorl, lacking entirely from the anal fasciole and from the base of the last whorl; spiral sculpture of 3 cords on the early spire-whorls becoming more numerous on the later, due to the intercalation of additional spirals; on the last whorl, the spirals number about 22,including those on the canal; anterior canal long and straight; anal sinus shallow; outer lip thin.

Length	diameter	last whorl,
47,	18,	32 mm.
67	27	47

This shell when full-grown appears distinct from the *lavinoides* but young specimens cannot be easily separated. This variety differs from the typical form, by its sharp, narrow, and widely spaced axial ribs, which produce a sharp, angled and not rounded shoulder to the periphery of each whorl. The anal fasciole is also wider and more smooth.

Gatun Stage: Toro Cays. Port Liman, coralline limestones.

Turricula taurina, n. sp. Plate 5, figure 3

Shell small, slender and fusiform; mucleus of nearly two smooth, convex whorls; post-nuclear whorls about seven; sutures appressed and bordered by a spiral cord; fasciole about one-half the width of the spire-whorls, smooth; the sculpture of the whorls is spiral, axial ribs lacking; on the spire-whorls there are four raised spiral cords with the flattened interspaces about three times the width of the spirals themselves; on the last whorl and anterior canal, there are 18 or 19 spirals; anterior canal, long, slender and strongly twisted or curved; outer lip simple; anal sinus as indicated by the growth lines is wide, moderately deep and occupies the middle of the fasciole.

Length 25, diameter 8, last whorl 16 mm.

This is a small and delicate species, characterized by its slender, fusiform outlines and lack of an axial sculpture. The spirals are narrow, raised cords, rather widely spaced. The single specimen was collected at Bocas del Toro.

Gatun Stage: Bocas del Toro, Panama.

Turricula Terryi, n. sp. Plate 5, figure 4

Shell small, slender and fusiform, with a long, evenly tapering spire and slender, twisted anterior canal; nucleus of two, smooth, small whorls, followed by 8 sculptured post-nuclear; suture appressed, bordered by a low, but wide, spiral cord; upper half or more of each spire-whorl, flat or slightly concave and forms the fasciole; fasciole nearly smooth or sculptured with few, low, faint spirals; early spire-whorls strongly sculptured with 12 or 13 axial ribs which are most heavy on the periphery of each whorl; these ribs become progressively weaker and on the last whorl are only feebly developed on the shoulder or periphery; spiral sculpture persistant but weak, consisting on the spire-whorls of 4 cords on the lower half, alternating with much weaker spirals; the fasciole as already noted is nearly smooth, or very weakly spiralled; on the last whorl, there are 20 spirals, including those on the anterior canal; aperture elliptical with a thin outer lip and long twisted anterior canal.

Length 23.5, diameter 7, last whorl 15 mm.

The small exposure of Gatun shales, on the east shore of Columbus Island, about one mile north of the city of Bocas del Toro, has yielded a large number of small interesting gastropods. More than a dozen species of Pleurotomids were collected at this place by Mr. R. A. Terry and the writer during a short period of collecting.

The *T. taurina*, also from this locality, is somewhat similiar but differs by its more convex whorls, deeper fasciole and pratically lacks all axial sculpturing.

Gatun Stage: Bocas del Toro, Panama.

Genus **TURRIS** Bolton

Turris albida Perry Plate 4, figres 1, 2

Pleurotoma albida Perry, 1811, Conch. Expl., pl. 32, fig. 4.

Pleurotoma virgo Lamarck, 1822, An. s. Vert., vol. 7, p. 94.

Pleurotoma haitensis Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 6, p. 50.

Pleurotoma virgo Moore, 1853, Quart. Jour. Geol. Soc. Lond., vol. 9, p. 130.

Pleurotoma barretti Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 290, pl. 17, fig. 6.

Pleurotoma antillarum Crosse, 1865, Journal de Conchyliologie, vol. 13, p. 34, pl. 1, fig. 8. Not of d'Orbigny.

Turris (*Surcula*) *virgo* Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, pp. 206, 207.

Pleurotoma albida Dall, 1890, Trans. Wagner Free Inst. Sci., vol. 3, pt. 1, p. 28, pl. 4, figs.8a.

Pleurotoma albida Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 343.

Pleurotoma haitensis Cossmann, 1913, Jour. de Conchyliologie, vol. 61, p. 16, pl. 2, figs. 1-4.

Pleurotoma cf. *antillarum* Cossmann, 1913, Jour. de Conchyliologie, vol. 61, p. 18, pl. 2, figs. 5, 6.

Turris albida Dall, 1915, Bull. 90, U. S. Nat. Museum, p. 38, pl. 5, fig. 13, pl. 14, fig. 7.

Turris albida Maury, 1917, Bull. Amer. Pal., vol. 5, p. 214, pl. 8, figs. 4-8.

This is a common species in the Gatun beds of Central America. The usual form is a large, strongly sculptured and shoulder shell, which corresponds best to the variety described by Guppy from Jamaica as *barretti*. Our largest specimen from Toro Cays, Panama measures as follows: Length 86, diameter 27, last whorl 56 mm. *T. albida*, is also a common fossil in the Miocene of Santo Domingo, Jamaica, Trinidad and Venezuela. Its geological range is from the Oligocene to the recent.

Gatun Stage: Gatun, C. Z.
Toro Cay, Water Cay, Panama.

Genus **LEUCOSYRINX** Dall

Leucosyrinx chloris, n. sp. Plate 5, fignre 19

Shell subfusiform, thin, with an acute spire and a long, straight, anterior canal; nucleus small, globular of about 2, smooth, convex whorls; post-nuclear whorls about 7; the spire-whorls are strongly angled in the middle, leaving a wide, concave or sloping zone about the upper suture; the sculpture consists of small, more or less confluent tubercles on the periphery of the whorls and number on the last whorl about 14; in addition, the whole surface is strongly sculptured with raised, subequal, spiral threads; base strongly contracted to the long, straight, anterior canal; the outer lip is broken; anal sinus, as indicated by the growth lines, lies in the concave zone, close to the upper suture.

Length 14.50, diameter 5.00, aperture 7.25 mm.

This appears to be a true *Leucosyrinx*, characterized by its thin shell, long, anterior canal and acute spire. It occurs in the Bocas shales with *Drillia lithocolletoides*, *cocosina*, *Terebra benthalis* var. *bocasensis* and others, shells which are all closely related to recent deep-water species.

Gatun Stage: Bocas del Toro.

Genus **ANCISTROSYRINX** Dall

Ancistrosyrinx elegans Dall, variety Plate 4, figure 17

Ancistrosyrinx elegans Dall, 1881, Bull. Museum Comp. Zool., vol. 9, p. 54.

Ancistrosyrinx elegans Dall, 1889, Bull. Museum Comp. Zool., vol. 18, pt. 2, p. 78, pl. 38, fig. 3.

The discovery of this elegant, recent species in the Gatun beds of Costa Rica is of more than usual interest, the record being based on a single, small but otherwise quite typical specimen from Hill 1a of the Banana River. Comparison with Dall's figure in the Blake Report, shows no important difference, except that the sculpture of the fossil shell is somewhat finer.

A. elegans, is recorded by Dall from the Florida Reefs and from 805 fathoms of water off Havana, Cuba.

The dimensions of our shell is as follows: Length 15, diameter 5.75, last whorl 11 mm.

Gatun Stage: Hill 1a, Banana River.

Ancistrosyrinx Dalli, n. sp. Plate 4, figure 16

Shell larger than the preceding and very nearly smooth; nucleus very small and smooth; post-nuclear whorls seven or more with a large and prominent, dentate or spinous keel; between the keel and the suture, there is a wide, nearly flat area, which carries a strong, smooth, median, spiral cord, behind which lies the small concave anal fasciole; the rest of the shell is smooth and without spirals;on the last whorl, the peripheral keel carries about 18 short, broad, spiny teeth; the canal is long, slender and straight; outer lip thin and fragile.

Length 14, diameter 7, last whorl 9.5 mm.
20 10, 15 mm.

Two specimens are represented in our collection, and the smaller but more perfect specimen is selected as the Holotype. It differs from the described species of *Ancistrosyrinx* by its nearly total lack of spiral sculpturing. The species is named for Dr. W. H. Dall of the National Museum, the author of the genus *Ancistrosyrinx*.

Gatun Stage: Toro Cay, Water Cay, Panama.

Genus **DRILLIA** Gray

Drillia venusta, Sowerby Plate 4, figure 9

Pleurotoma venusta Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 6, p. 50, pl. 10, fig. 7.

Pleurotoma venustum, Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 289.

Turris (*Drillia*) *venusta*, Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 208.

Pleurotoma venusta, Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 527.

Pleurotoma venusta, Guppy and Dall, 1896, Proc. U. S. Nat. Museum, vol. 19, p. 305.

Drillia venusta Maury, 1917. Bull. Amer. Pal., vol. 5, p. 216, pl. 8, figs. 13, 14.

The *Drillia venusta* and *consors* of Sowerby, are the two commonest Pleurotomids in the Gatun beds of Costa Rica. Both are characterized by a neat, regular and reticulate sculpture of spirals and axial ribs. In *venusta*, the anal fasciole is narrow, and appears as a deep constricted zone, encircling the upper part of each whorl. The spirals are narrow bands, produced between deep, incised lines and in typical specimens number on the last whorl about 18. The canal is rather long and usually more or less twisted.

Drillia venusta, occurs also in the Miocene of Jamaica, Trinidad and in Santo Domingo.

Gatun Stage: Gatun, C. Z.
Banana River, Port Limon.

Drillia consors, Sowerby Plate 4, figures 8, 10, 13

Pleurotoma consors, Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 6, p. 50.

Pleurotoma consora, Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 280.

Turris (*Drillia*) *militaris*, Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 207. Not of Hinds, 1843.

Pleurotoma consors, Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 527.

Drillia militaris, Gabb, 1881, Jour. Acad. Nat. Sci. Phila., vol. 8, and series, p. 337.

Pleurotoma alesidota, Dall, var. *magma* Bose, 1908, Bol. Inst. Geol de Mexico, No. 22, p. 47, pl. 5, figs. 30, 31, 33, 45,

Pleurotama sp. aff. *Pl. alesidota* (Dall) var. *macilenta* Toula, 1911, Jahrb. der K-K Geol. Reichsanstalt Wien, vol. 61, p. 506, pl, 30, fig. 11. Not *alesidota* or *macilenta* Dall, 1889.

Drillia consors Brown and Pilsbry, 1911, Proc. Acad Nat. Sci. Phila., vol. 63, p. 345.

Drillia consors, Cossmann, 1913, Jour. de Conchyliologie, vol. 61, p. 20, pl. 2, figs. 8-14.

Drillia consors, Maury, 1917, Bull. Amer. Pal., vol. 5, p. 216, pl. 8, figs. 15, 16.

This species is easily distinguished from the *venusta*, by its more slender form, wide but shallow anal fasciole, sharper sculpture and straight, longer, anterior canal. The most common variety, illustrated by figure 10, averages in length about 35 mm. The axial ribs are numerous (about 28), straight or slightly oblique and only slightly heavier than the raised spiral cords. In addition the surface is overrun by fine and almost microscopic spirals. Figure 8 of a large variety from Grape Point, has about 9 whorls and measures 60 mm in length. The early spire-whorls have the usual sculpture as seen on typical *consors*. On about the seventh whorl, the ribe increase suddenly to nearly twice their normal number. They gradually become obsolete, so that on the last whorl, pratically only the spirals are left. The fine, microscopic spirals seen on typical *consors* are lacking.

The *Drillia alesidota* and its variety *macilenta* Dall of the recent West Indian fauna, are closely related to *consors*.

Gatun Stage: Mt. Hope, C. Z.
Banana River, Port Limon.
Boras.

Drillia cf. **moensis**, Gabb

Drillia moensis, Gabb, 1881, Jour. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 351, pl. 46, fig. 33.

A single small speimen of a *Drillia* was collected from the coral limestones near Limon, which agrees partly with Gabb's figure and description. Our specimen has 7 instead of 8 ribs, and lacks the sutural spiral mentioned by Gabb. The dimensions of this shell are: Length 12.5, diameter 4.5, last whorl 7 mm.

Gatun Stage: Port Limon.

Drillia papaya, n. sp. Plate 4, figure 5

Shell of medium size, slender and subfusiform; whorls 10 (mucleus eroded); anal fasciole, a deep concave zone, occupying about 1-3 of a whorl interval and bordered above by a small sutaral cord; sculpture of heavy, knob-like ribs, crossed by spiral threads of different strengths; axial ribs about 6 on the last whorl, lacking from the fasciole and from the base and anterior canal; spiral sculpture of primary secondary and tertiary threads, there being about four primary threads on each spire-whorl, on the last whorl there are 8 or more primary threads, with an intermediate secondary and finer tertiary threads on each side; the anterior canal has numerous threads of varying strength; aperture long and subelliptical; anterior canal long and slightly bent backwards; anal sinus as indicated by the growth lines is deep and wide.

Length 32, diameter 10, last whorl 19 mm.

A single specimen was collected from certain sandstones of Lower Gatun age from a small tributary stream of the Rio Cocles near Old Harbor, C. R. The recent *Drillia haliostrephis* Dall from the Gulf of Mexico appears closely related, but the fossil shell has a more slender spire and slightly longer anterior canal.

Gatun Stage: Rio Cocles, C. R.

Drillia coccos, n. sp. Plate 5, figure 7

Shell small, slender and fusiform; whorls 10 or more, nucleus eroded; fasciole deep and concave, about ½ of the width of a spire-whorl, bordered above by a strong sutural cord, otherwise smooth; sculpture of strong axial ribs, which are lacking from the fasciole and from the base of the last whorl; these ribs number on the last whorl about 10; the ribs are crossed by strong, raised cord-like spirals, there being at first 2 on the earliest spire-whorls and on the later 3; the last whorl shows 8 spirals and the wide interspaces are occupied by 3 or more smaller ones; additional and more crowded spirals occur on the long slender canal; anterior canal long and slender, slightly bent.

Length 21, diameter 6, last whorl 12 mm.

A small, very slender and fusoid species with strong, persistent spiral and axial sculpture. A single specimen was collected at Coco Plum, a small cocoanut plantation about 40 miles east of Bocas del Toro.

Gatun Stuge: Coco Plum.

Drillia chiriquiensis, n. sp. Plate 5, figure 2

Shell solid of medium size; whorls 7 (apex lost), of slightly convex profile; anal fasciole small but quite deep and nearly smooth; suture strongly appressed and bordered just below by a strong, elevated spiral cord; sculpture of numerous, somewhat oblique riblets and numerous weak spirals; the ribs commence at the lower edge of the fasciole, pass slightly obliquely across the whorls to the suture or on the last whorl across the base to the canal; the ribs on the last whorl number 15 or 16; spirals of numerous weak threads which are generally alernating in character; the spirals are very small on the fasciole, quite large and coarse on the anterior canal; the outer lip is heavily thickened by a large rib; anterior canal short and bent.

Length 25, diameter 8, last whorl 15 mm.

A single shell from Bocas, serves as type for this species. It recalls the *D. consors* Sowerby, but differs in its much finer sculpture.

Gatun Sage: Bocas del Toro, Panama.

Drillia citria, n. sp. Plate 5, figures 12, 13

Shell small; whorls about 8, of which the first 2 belong to the small, obtuse, smooth nucleus; the post-nuclear whorls are strongly sculptured with ribe and spirals; the upper 1-3 of the spire-whorls carries a concave fasciole, bordered posteriorly by a strong sutural cord to the 1st post-nuclear whorl; the fasciole is smooth or only faintly sculptured with fine spirals; the sculpture consists on the last whorl of about 9 ribs which fade out rapidly on the base and on the fasciole; the ribs are crossed on the early spire-whorls by 2 spiral cords, becoming 3 on the later; on the last whorl there are 12 more of which 6 are on the anterior canal; the intervals between the spirals, are 3 or more times as wide as the spirals themselves and are sculptured with fine spirals threads; aperture sub-elliptical, with a short and slightly twisted anterior canal; anal sinus moderate.

Height 11, diameter 4 mm.

A small species, common in the coralline phase of the Gatun at Port Limon.

Gatun Stage: Port Limon.

Drillia aquanica, n. sp. Plate 5, figures 16, 17

Shell small, slender with a long spire and a shorter last whorl; whorls about 11, the nucleus composed of 2 small, smooth convex whorls and about 9 post-nuclear; whorls strongly sculptured with ribs and spiral cords; fasciole nearly 1-3 the width of the spire-whorls, marked with fine spirals and bordered posteriorly by a strong sutural cord; the spiral sculpture consists on the early whorls of 2, later 3 and finely 4 cords on the penultimate whorls; the last whorl has 8 spiral cords and 10 others on the canal; the spiral cords are separated by interspaces of slightly greater width; the interspaces are finely striated with small spiral threads; the axial sculpture consists of about 9 knot-like ribs over which pass the enlarged spiral cords; the ribs pass over the base of the last whorl to the canal and slightly over the facciole; aperture elliptical with a short, straight canal.

Height 18, diameter 6, last whorl 9 mm.

This is a diminutive of *Drillia fusiformis* of the Miocene of Santo Domingo, the two species having practically the same sculpture. *Drillia fusiformis* of 11 whorls measures 35 mm in length, while *aquanica* of the same number of whorls has a length of only 19 mm. The Maury collection contains a small but quite typical specimen of *aquanica* from the Rio Gurabo, Santo Domingo.

Gatun Stage: Water Cay.

Drillia limonica, n. sp. Plate 4, figure 15

In general form like *Drillia consors* Sowerby, with a long spire and but slightly shorter anterior canal; whorls about 8½ of which 1½ belongs to the small, smooth, blunt nucleus; the post-nuclear whorls are sculptured with ribs and weaker spirals; on the 1st three whorls, the anal fasciole is but slightly differentiated; it increases slowly in strength until on the later whorls it has become a concave zone as in *consors*; a sutural cord is introduced on the 2nd post-nuclear whorl and is present on all the succeeding whorls; on the spire-whorls there are about 11, widely spaced ribs; these ribs are lacking from the anal fasciole, except on the very earliest whorls, where they are faintly continued towards the upper sutures; on the last whorls, the ribs are smaller and number about 13; between these main ribe on the last whorl there appear occasionally smaller and shorter ribs which do not reach to the edge of the fasciole; there are 5 faint spirals crossing the ribs on the spire-whorls and very much finer ones in the anal fasciole; the last whorl shows about 10 spirals together with others on the canal; aperture elongate with the anterior canal rather long and straight.

Length 19, diameter 6.5 mm.

Like the *Drillia consors* in form, this species is distinguished by its fewer ribs and shallower anal faciole. The ribs on the earlier whorls are oblique, but become very nearly straight and vertical on the later.

Gatun Stage: Port Limon.

Drillia bocatoroensis, n. sp. Plate 5, figure 6

Shell of medium size, solid and strongly sculptured with ribs and spirals; whorls about 11, the nucleus eroded in the type specimen; fasciole occupying about 1-3 of the width of the spire-whorl, with a large sutural cord above which the edge of the suture is finely and regularly beaded or granulated; the surface of the fasciole is slightly undulated by the obsolete ends of the ribs, otherwise smooth; axial ribs about 8 on the last whorl, straight and nearly in line across the face of the spire-whorls to the apex, but interrupted and lacking from each fasciole; spiral sculpture of the few raised cords with wider interspaces; there are 3 spirals on the spire-whorls, about 6 on the last, with 9 more on the anterior canal; the interspaces in addition carry fine and submicroscopic spiral lines; the base of the last whorl is somewhat constricted with a short anterior canal.

Length 23, diameter 8, last whorl 13.5 mm.

From the several species of fusoid Pleurotomids in the Gatun beds of Panama and Costa Rica, this species differs in its heavy, persistent ribs and sharp spiral sculpturing. The fasciole is nearly smooth, bordered above by a heavy sutural cord.

Gatun Stage: Bocas del Toro.

Drillia theobroma, n. sp. Plate 5, figure 11

Shell subfusiform; whorl 7 (apex broken); fasciole a narrow, concave zone, not strongly differentiated from the rest of the whorl, spirally sculptured and bordered above on the early spire-whorls by a sutural cord; sculpture consists on the spire-whorl of about 10 low ribs, becoming more numerous and subobsolete on the last; the spiral sculpture consists of raised, alternating, revolving cords; there are 2 or 3 spiral cords on the early spire-whorl, becoming 5 or more on the later; the last whorl has about 10 spirals in addition to those on the anterior canal; between each pair of the main or primary spirals there is a smaller, secondary spiral; base rounded or contracted to the slender anterior canal.

Length 21, diameter 7.5, last whorl 13 mm.

It is possible that this species, belongs to the genus *Glyphostoma*, as the type specimen seems to show a slightly thickened and inflated outer lip. The aperture is however so completely filled with a rocky matrix, that this observation cannot be fully verified. The axial sculpture is practically lacking from the last whorl, leaving a surface simply marked with the rough spirals.

Gatun Stage: Bocas del Toro.

Drillia aurantia, n. sp. Plate 5, figure 15

Shell small, solid; whorls about 9; the nucleus consists of about 1½ smooth, convex whorls which through the gradual introduction of the ribs, followed by the spirals blend in with the post-nuclear whorls; the anal fasciole is rather wide (about 1-3 of the spire-whorl) and shallow; it uppears very early and carries from the start a strong, sutural cord; the sculpture consists of numerous closely spaced, linear ribs which are absent from the anal fasciole; these ribs number on the last whorl about 21; the spirals are uneven threads which are strongest below and on the base; the fasciole also carries one or more fine threads except on the base of the last whorl; the spirals do not cross the ribs so that the summit of the ribs are left nearly smooth; aperture small with a short, slightly twisted anterior canal.

Length 11, diameter 4 mm.

A small species sculptured like the *D. elegans* Conrad of the Chesapeake Miocene of Virginia, but with more numerous and more closely spaced ribs.

Gatun Stage: Port Limon.

Drillia musacina, n. sp. Plate 5, figures 27, 28

Shell small, slender; the nucleus of about 2 whorls, the 1st blunt, convex and smooth, followed by the 2nd which is strongly carinate; there are 7 post-nuclear whorls of slightly convex profile; the fasciole is a narrow band on which the ends of the ribs become strongly deflected to the left; the axial sculpture of about 16, narrow ribs on the last whorl; the ribs are continuous across the spire-whorls to the upper sutures but become bent and strongly deflected on the fasciole; on the last whorl, the ribs are continued to the base of the canal; the spirals vary somewhat in strength but are usually subregular spiral bands of which there are 7 or 8 on the spire whorls and about 14 on the last whorl and the canal; the back of the last whorl is strongly humped; the outer lip was probably thin (broken in all our specimens); canal short, straight.

Length 9, diameter 2.75, last whorl 5.00 mm.

A small species abundant in the Gatun beds of the Banana River.

Gatun Stage: Hill 1a, Banana River.
Hill 3, Banana River.

Drillia estrellana, n. sp. Plate 10, figures 31, 32

Shell very small, solid, porcellaneous; slender with a long spire and a short body-whorl; nucleus small of 2 smooth, convex whorls; post-nuclear whorls about 7; sculpture with strong ribs and impressed spiral lines in their interspaces; the anal fasciole is a constricted band about the upper 1-4 of the whorl and which passing over the ends of the ribs dislocates them as in *Terebra;* there are 11 ribs on the last whorl which commencing at the upper suture pass across the sutural fasciole but somewhat diminished in strength, continue across the face of the whorl in a slightly oblique direction to the columellar region; the summits of the ribs are smooth but the interspaces are sculptured with impressed lines produced by spiral bands of regular width; there are 4 such bands on the spiral-whorls and about 12 on the last whorl, including a few on the canal; aperture small, subelliptical and a short twisted canal.

Height 7.5, diameter 1.75 mm.

A small species of Terebroid appearance, the ends of the ribs being strongly dislocated as they pass across the small anal fasciole.

Gatun Stage: Coll. 7, Estrella River.

Drillia limonetta, n. sp. Plate 5, figure 10

Shell small, solid, porcellaneous; whorls about 8, coarsely ribbed and polished; fasciole absent; the sculpture consists of moderately strong ribs which on the spire-whorls pass suture to suture but are only slightly flexed near the upper suture; on the last whorl, the ribs number about 11; the last rib is much enlarged and forms the outer lip; the ribs are but shortly continued upon the base and do not reach the canal; in addition, the surface is covered with fine, irregular threads which are nearly obsolete on the upper portions of the whorls but are strong on the base and on the canal; aperture subelliptical with a short canal, somewhat bent or excavated ventrally; anal sinus simply as a vertically directed notch at the junction of the outer lip with the body-whorl and is bordered by a tooth-like denticle on its inner side.

Length 12.25, diameter 5.00, last whorl 7.25 mm.

A small, solid and porcellaneous species, belonging to Dall's *Cymatosyrinx*. The sutural fasciole being absent, the ribs are continuous to the upper suture and the surface is finely striated with small, irregular spiral threads.

Gatun Stage: Port Limon.

Drillia carruca n. sp. Plate 4, figure 11

Shell of medium size, solid; whorls 7 plus (apex broken), rather rapidly tapering; no fasciole; axial sculpture of about 8, narrow ribs with deep and wider interspaces; the ribs commence at the top of the canal and pass across the whorls to the sutures; the ribs are nearly in line across the spire-whorls to the apex; spiral sculpture of slightly elevated cords, separated by wide, flat interspaces; there are about 7 spiral cords on the spire-whorl; with 12 on the last whorl; aperture sub-elliptical, the outer-lip somewhat thickened and a short canal.

Height 18, diameter 7.25, last whorl 11 mm.

This shell resembles *Drillia musa* in its general sculpture of fine, widely spaced, spiral cords.

Gatun Stage: Coll.4, East Grape Point Creek.

Drillia limonensis, n. sp. Plate 5, figures 8, 9

Shell of medium size and in form recalling *D. venusta* Sowerby; nucleus of nearly three, smooth convex whorls; post-nuclear whorls 8; anal fasciole scarcely perceptible on the early whorls, becoming on the later, simply a narrow, constricted zone, bordering the suture; sculpture of rather numercus riblets, which are abruptly bent to the left near the posterior suture on crossing the constricted anal fasciole; three ribs number on the last whorl about 15; the spiral sculpture consists of very fine threads; the space between each pair of adjacent spiral threads is finely and microscopically decussated by the raised lines of growth, producing a shagreening of the whole surface; in mature,shells, the last rib becomes unusually large and heavy, producing a large and strongly thickened outer lip; canal short, slightly bent inward or outwards; callous on the inner lip.

Length 20, diameter 7.5, last whorl 11 mm.

The general form of this shell is that of *Drillia venusta* Sowerby, which it also recalls in its constricted anal fasciole. The whole surface appears minutely shagreened, an effect produced by the fine, sub-microscopic, spiral threads as well as a minute decussation of their interspace. This species is fairly abundant in certain sandy layers found intercalated in the hard and generally barren coral-reef limestone along the sea-front at Port Limon.

Gatun Stage: Port Limon.

Drillia Cristobali, n. sp. Plate 5, figure 1

Shell of the general form of *uenusta*, rather solid; whorls 6, (apex broken in the type specimen); anal fasciole a narrow constricted zone, bordering the upper suture; no sutural cord; sculpture of numerous, straight, parallel ribs and fine spirals; ribs on the early whorls about 12, becoming about 19 on the last; on the anal fasciole, the ribs are shortly deflected or bent; spirals very numerous and on slight magnification seen to consist of narrow, even raised threads with interspaces of nearly twice the width of the spirals themselves; anterior canal rather short and slightly bent backwards; aperture sub-ellipitical with a thin outer lip; anal sinus small and shallow.

Length 20, diameter 8.5, last whorl 11.5 mm.

This species, like the *limonensis*, has the general form and constricted fasciole of *Drillia venusta* Sowerby, but differs by its smaller size, short canal and quite different spiral and axial sculpture. *D. limonensis*, is more closely related, but that species differs in its more slender form and peculiar submicroscopic sculpture.

The single specimen serving as the type, was collected from the Gatun shale, exposed about a mile north of the city of Bocas del Toro, on Columbus or Cristobal Island.

Gatun Stage: Bocas del Toro, Panama.

Drillia bocasensis, n. sp. Plate 5, figure 5

Shell of medium size, solid; nucleus of about 2 smooth whorls; post-nuclear whorls about 10; anal fasciole a narrow constricted zone, nearly filled with a large, sutural cord; axial sculpture of large, heavy ribs, about 9 on each whorl; the ribs pass from suture to suture and on the last whorl across the base to the anterior canal; a large, hump-like rib is developed on the back of the last whorl, formed during a resting stage; no spirals; the growth-lines produce a minute but characteristic sculpture of heavy, raised threads, which pass obliquely across the surface of the whorls and ribs, and follow the curve of the anal sinus across the fasciole; the sutural cord is finely granulated by the raised growth-lines; canal short but straight; outer lip large, with a deep anal sinus at its posterior union with the body-whorl.

Length 22, diameter 8, last whorl 12 mm.

This species should more properly be referred to the genus *Cymatosyrinx* Dall, based on the *Pleurotoma lunata* H. C. Lea, a Chesapeake Miocene fossil. The form and general sculpturing of *bocasensis* is similiar to that of many species of this group but it may be recognized at once by its very peculiar, submicroscopic sculpture formed by the close, heavy growth-lines.

Gatun Stage: Bocas del Toro.

Drillia aquaensis, n. sp. Plate 5, figure 25

Shell small and solid; nucleus of 1+ whorls (mostly broken on type specimen); post-nuclear whorls about 8; anal fasciole lacking; axial sculpture of about six, large, heavy and straight ribs, which pass from suture and across the base of the last whorl onto the anterior canal; each set of ribs is in a straight line from the canal across the spire-whorls to the apex; spiral sculpture of about 8 impressed lines which produce a series of flat but quite wide, spiral bands; on the last whorl there are about 22 spiral bands; much finer near the suture, larger and wider on the middle of the whorl and on the canal; canal short and slightly bent to the left; inner lip calloused.

Length 15, diameter 5.5, last whorl 8.5 mm.

Characterized by its six axial ribs and finer sculpture of flat, spiral bands. It belongs to the genus *Cymatosyrinx* of Dall.

Gatun Stage: Water Cay, Panama.

Drillia musa, n. sp. Plate 5, figure 26

Shell about the same size as the preceding but with a more slender spire; nucleus of 2 smooth whorls (broken); post-nuclear whorls about 8; no fasciole; axial ribs about 9, pass from suture to suture and across the base to the anterior canal the ribs are in line across the whole series of spire-whorls; spiral sculpture quite heavy, consisting of raised threads with wider interspaces; the spirals number on the spire-whorls 8 or 9, and on the last whorl about 22; aperture large and suboval; anterior canal short, narrow and heavily calloused to form the inner lip.

Length 17; diameter 6, last whorl 9 mm.

Related to the preceding, but differs by its more slender form; with 9 instead of 6 ribs and a much coarser spiral sculpture.

Gatun Stage: Banana River, C. R.

Drillia lithocolletoides, n. sp. Plate 5, figure 18

Shell small, glassy or translucent; nucleus of about 3 smooth, convex and glassy whorls, followed by 6 post-nuclear whorls; the whorls are strongly angled in the middle by tubercular-like ribs but leaving a concave zone about the upper sutures which forms the anal fasciole; on the last whorl, the ribs or tubercles number 11; are set obliquely and on the back of the whorl, they are continued slightly over the base; the surface is smooth and polished; last whorl slightly constricted above the short, straight canal; aperture subovate.

Height 10.75, diameter 3.25 mm.

The *Drillia lithocolleta* Watson is a recent deep-water species, dredged by the Challenger and the Blake, at several stations in the West Indies and off the Florida coast, from depths of 400 to nearly 1000 fathoms. The Bocas shell seems to be very closely related to the recent species; differing only from Dall's figure in the Blake Report (plate 11, fig. 61), in being somewhat more slender, with heavier tubercles and a longer base.

Gatun Stage: Bocas del Toro.

Drillia cocosina, n, sp. Plate 5, figure 14

Shell small, glassy or translucent in texture; spire twice or more the length of the last whorl and the canal; whorls 8 plus, the earlier ones missing; no anal fasciole; the sculpture consists at first of a lower row of small tubercles, but a second or upper row soon begins to appear and on the last whorl, this upper set of tubercles is very nearly equal to the lower; the last whorl has about 13 of these tubercles, in addition the whorl is finely sculptured with fine, regular, closely spaced spiral threads which cover the entire whorl and the canal, but leaving the tops of the tubercles smooth; aperture ovate, with a short, twisted canal.

Length 12, diameter 3.5 mm.

This interesting species from the shales near the city of Bocas del Toro, is related to the recent *Drillia oleacina* Dall dredged from rather deep water in the Gulf of Mexico and elsewhere in the West Indies. In differs from that species in being less slender and with a larger body-whorl.

Gatun Sage: Bocas del Toro.

Genus GLYPHOSTOMA Gabb

Glpyhostoma dentifera, Gabb.

Glyphostoma dentifera Gabb, 1872, Proc. Acad. Nat. Sci. Phila., vol. 24, p. 270, pl. 11, fig. 4.

Glyphostoma dentifera Gabb, 1873, Trans. Amer. Phil. Soc. vol. 15, p. 210.

Glyphostoma dentifera Dall, 1889, Bull. Mus. Comp. Zool., vol. 18, pt. 2, p. 108.

Glyphostoma dentifera Cossmann, 1913, Jour. de Conchyliologie, vol. 61, p. 31, pl. 2, figs. 15, 16, 17.

Glyphostoma dentifera Maury, 1917, Bull. Amer. Pal., vol. 5, p. 225, pl. 9, fig. 16.

A single specimen of this species was collected from the coralline phase of the Gatun, near Port Limon. The shell showing 5 whorls (apex lost), measures 18 by 8 mm. The pecular shagreening, characteristic of the genus is strong and easily seen.

This shell agrees closely with the figure given by Cossmann, based on a Dominican specimen. It differs in several respects from the specimen figured by Dr. Maury in her Dominican Fossils from a metatype, sent by Professor Gabb to the Cornell Museum. Dr. Maury's shell is larger, has a longer spire, and the microscopic shagreening is much finer.

Dall in the Blake Report, doubtfully refers to this species, an imperfect specimen collected in 15 fathoms of water at Sand Keys.

Gatun Stage: Port Limon.

Glyphostoma moinica, n. sp. Plate 5, figures 29, 30

Shell small, solid with a coarse, tuberculate, subreticulate sculpture and a thickened, enlarged onter lip; nucleus small, pointed and tapering of 3 or more, smooth, convex whorls followed by about 4 post-nuclear; the sculpture consists of about 14 narrow ribs continuous from the canal to the upper suture and crossed by even, spiral cords; their intersection form small rounded beds or tubercles; immediately after the nucleus, there is but one spiral, soon followed by two and on the penultimate there are three; the last whorl has five spirals and three or four more on the canal; aperture elliptical with a large expanded outer lip, smooth within and a deep, anal sinus at its upper end; canal short and straight.

Height 5.75, diameter 2.75, last whorl 3.75 mm.

A small species doubtfully referred to *Glyphostoma*, having the outer lip smooth within and lacking the peculair, submicroscopic structure of typical *Glyphostoma*.

Its sculpture is coarse, the intersection of the ribs and spirals forming small beads or tubercles.

Gatun Stage: Port Limon.

Genus **CYTHARA** Schumacher

Cythara terminula var. **costaricensis**, n. var. Plate 5, figures 21, 22

cf. *Cythara terminula* Dall, 1890, Trans. Wagner Free Inst. Sci., vol. 3, pt. 1, p. 38, pl. 2, fig. 5.

The *Cythara terminula* Dall, to which the present shell appears closely related, was described from the Caloosahatchie beds of Florida, of Pliocene age. The Costa Rican shell with the same number of whorls is somewhat small (typical *terminula* of 7 whorls, 16 mm), (variety *costaricensis* 7 or 8 whorls, 13 mm), and has 8 instead of 9 ribs. The details of the spiral sculpturing is very similiar, consisting of flattened bands separated by sharp channels. The spiral bands carry a central incised line, which produce the appearance of being in pairs.

C. cercadica Maury from Santo Domingo, is a larger species with higher spire and simple and not banded spirals.

Length 13, diameter 5, last whorl 10 mm.

Gatun Stage: Hill 1a, Banana River.

Cytharella limata, n. sp. Plate 5, figure 20

Shell small, nearly smooth and porcellaneous; spire slightly shorter than the narrow aperture; nucleus of about 3½ smooth, convex whorls, the last ½ turn being very finely and closely ribbed; there are 3½ post-nuclear whorls; sculpture consists of narrow, slightly oblique ribs which pass across the spire-whorls from suture to suture and on the last whorl follow down on the anterior canal to its tip; there are 8 ribs on the last whorl; the spaces between the ribs are wide, flat and smooth; the tops and sides of the ribs themselves are carved or etched with fine, subobsolete spiral lines; aperture linear-elliptical, the outer lip somewhat thickened by the last rib, but smooth within; anterior canal long straight.

Height 9, diameter 3.50, last whorl 7mm.

Gatun Stage: Port Limon.

Genus **BORSONIA** Bellardi

Borsonia cocoensis, n. sp. Plate 5, figures 23, 24

Shell small, biconic; whorls about 7; nucleus of 2, nearly smooth whorls, followed by 5 strongly shouldered post-nuclear whorls, the angle of which on the spire-whorls comes just above the lower suture; above the shoulder, the whorls are flat or slightly concave to the upper suture; sculpture with a double or triple beaded cord on the periphery and with alternating beaded spirals both above and below; on the last whorl, the primary spirals number 15 or 16, above the shoulder 3 or 4; the suture is bordered in front by a strong cord; pillar long, slightly twisted in front and with 2 sharp, plications; the anal sinus lies on the peripheral angle as in typical *Turris*.

Length 16, diameter 8, last whorl 11 mm.

The present species is based on two specimens from Coco Plum about 30 miles east of the city of Bocas del Toro. The *B. varicosa* Sowerby from the Dominican Miocene, is a related species, differing in its porportionately longer spire.

Gatun Stage: Coco Plum.

Genus **SCOBINELLA** Conrad

Scobinella Morierei (Laville) Cossmann Plate 4, figures 3, 4

Euchilodon Morierei Laville, in Cossmann, 1913, Jour. de Conchyliologie, vol. 61, p. 34, pl. 3, figs 6, 7.

Shell of medium size, with spire and last whorl of nearly equal lengths; sculpture of numerous, close, bead-like spiral cords, 3 or 4 on the spire-whorls, 18 or more on the last whorl and canal; the sutural fasciole is rather narrow, shallow and concave and with 4 much finer beaded cords; the suture is bordered in front by a heavy beaded spiral, which on the early spire-whorls, nearly fills the entire fasciole ; columella with four sharp folds, the largest above; canal nearly straight; aperture narrow, with a lirated outer lip.

Length 49, diameter 15, last whorl 33 mm.

This is one of the most elegantly sculptured Pleurotomoids in the Gatun beds of Panama and Costa Rica. Described by Laville and Cossmann from Mindi in the Canal Zone, we have in addition collected the species from Toro and Water Cay, (where it is fairly common), Bocas del Toro and from Limon. The predominating spiral sculpture and columellar folds are very suggestive of *Mitra*.

Gatun Stage: Mindi, C. Z. (*Laville and Cossmann*)
Toro aud Water Cays, Panama.
Bocas del Toro, Panama.
Port Limon, coral limestones.

Genus **HALIA** Risso

Halia americana, n. sp. Plate 4, figure 7

Shell large, thin, buccinoid in form; spire elevated with shouldered whorls and deep sutures; whorls 3 plus, the earlier ones missing; the profile of the whorls is convex with a wide, shouldered, flattened or even slightly concave band just in front of the suture; the surface of the spire-whorls is smooth and unsculptured but the early ones show very faint spiral bands; the upper half of the body-whorl is smooth but below, the whorl carries about 16, low, faint, spiral ribbons like those of *Malea* but much less strong; these spiral ribbons average about 1.25 mm in width; the growth lines cross the face of the whorl from the tip of the canal to the shoulder angle in a slightly convex curve, the convex side of which is towards the aperture; from the shoulder angle to the suture the growth lines are reversed with the concave side facing the aperture; aperture broadly elliptical; the canal was probably short and turned inward or ventrally.

Height 66, diameter 39 mm.

This truly remarkable species evidently belongs to the Pleurotomoid genus *Halia*, of which the 4 known species are European and North African in their distribution. Its type species *Halia Priamus* Meuschen is living off the coast of Spain and North West Africa. According to Cossmann, there are three Tertiary species in Europe, *H. præcedens* Pant. from the Helvetian of Italy, *H. Deshayeseana* da Costa in the Tortonian of Portugal and Italy, and *H. helicoides* Br. in the Plaisancian of the maritime Alps.

The European species are described as being entirely smooth, but the Gatun shell is sculptured on its lower half with ribbon-like spirals bands.

Gatun Stage: Mt. Hope, C. Z.

Genus **CANCELLARIA** Lamarck

Cancellaria dariena Toula Plate 6, figure 8

Cancellaria dariena Toula, 1909, Jahrb. K-K. Geol. Reichsanstalt, Wien, vol. 58, p. 31, pl. 25, fig. 13, pl. 28, fig. 2.

Cencellaria dariena Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 345, pl. 24, figs. 3, 4.

Cancellaria darienesis Cossmann, 1913, Jour. de Conchyliologie, vol. 61, p. 51, pl. 4 figs. 9, 10.

var. *trachyostraca* Brown and Pilsbry.

Cancellaria dariena, var. Toula, 1909, Jahrb. der K-K, Geol. Reichsanstalt Wien, vol. 58, p. 37, pl. 28, fig. 11.

Cancellaria dariena var. *trachyostraca* Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 345, pl. 23, figs. 1, 2.

This species is most abundant in the Canal Zone. It is distinguished from the *Barretti* Guppy, which it most closely resembles by its shorter spire, larger body-whorl and a more irregular spiral sculpture. A large specimen from Mt. Hope, C. Z., has the following dimensions: Length 38, diameter 22; last whorl 30 mm. Shorter and more globose shells form the variety *trachyostraca* Brown and Pilsbry.

Gatun Stage: Gatun and Mt. Hope, C. Z.
Water and Toro Cays, Panama.
Rio Cocles, C. R.

Cancellaria Barretti Guppy Plate 6, figure 6

Cancellaria Barretti Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 289, pl. 17, fig. 11.

Cancellaria reticulata Gabb, 1873, Trans, Amer. Phil. Soc., vol. 15, p. 236. In part.

Cancellaria Barretti Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 520.

Not *C. Barretti* Maury, which is *C. Mauryæ*, n. sp.

This species is the West Indian Miocene analogue or the recent *Cancellaria reticulata* Linné. The most important difference to be noted between the two shells is that in *Barretti* the columellar plicæ are more anteriorly situated and heavier. It is a Miocene fossil in the Bowden beds of Jamaica.

Gatun Stage: Banana River

Cancellaria Cossmanni, n. sp. Plate 6, figures 9, 11

Shell of medium size, solid; nucleus of 3, small, smooth whorls; post-nuclear whorls 5, sutures deep; the whorls are slightly channeled or coronated just below the sutures; sculpture is evenly but coarsely reticulated by numerous, slightly oblique, narrow ribs, crossed by heavy, raised, narrow, spiral cords; the last whorl show 21 or 22 ribs; the spirals consists of narrow, raised cords, separated by wide, deep interspaces; there are 4 spirals on the spire-whorls, with 15 on the last whorl and the canal; base of last whorl rounded and contracted to the short, beak-like anterior canal; columella with 2, narrow, but strong plications, of which the upper is much the strongest; aperture sub-elliptical with the outer lip carrying 8, narrow, entering liræ.

Length 25, diameter 14.5, last whorl 18 mm.

This shell should probably be considered as a variety of *C. Barretti* Guppy, but in the large series in our collection, the shell is always much smaller and with a much coarser and heaver sculpture. In some specimens, this sculpture becomes quite sharp and harsh, brought about by the crossing of the narrow spiral cords and equally narrow axial ribs.

It is an abundant and characteristic species of the Gatun beds along the Banana River, C. R.

Gatun Stage: Banana River.

Cancellaria Mauryæ, n. sp. Plate 6, figure 5

Cancellaria Barretti Maury, 1917, Bull. Amer. Pal., vol. 5, p. 226, pl. 10, fig. 1. Not of Guppy, 1866.

Shell large, ovate; an evenly conic spire in height less than the length of the aperture and a large, evenly convex last whorl; the nucleus is rather small, of 2 smooth, convex whorls followed by about 6 post-nuclear whorls; the profile of the spire-whorls is slightly convex with deep, distinct suture; the sculpture is cancellate or reticulate, the spirals and ribs of very nearly equal strength; of the axial ribs there are 40 or more on the whorl, crossed by 24 spiral cords; on the spire-whorls there are 5 spiral cords becoming 7 on the penultimate; the spirals are fairly regular, separated by interspaces 1½ times their width, in which smaller spirals may occasionally appear; faint indications of resting marks show as crowding of the ribs or as smooth, slightly humped spaces; aperture large, ovate; a thin outer lip with 17, long entering liræ; columella with 2 simple plicæ, of which the upper is much larger; a third is probably developed on the anterior border of the canal; a well marked ridge about the base and a strong siphonal fasciole.

Height 36, diameter 23, last whorl 29, aperture 24 mm.

This shell was figured by Dr. Maury in her Dominican fossils as *C. Barretti* of Guppy, but it differs from that species in much shorter spire, more globose shell, larger aperture and by its columellar plicæ. In the species closely related to the *reticulata*, such as *Barretti*, *Cossmanni* and others, the columellar plicæ are heavy and the posterior one is usually more or less bifid. In this species, the posterior plication is large, wide and thin, especially in the interior of the shell.

The Costa Rican collection is limited to a single, imperfect specimen, so we have used as the type of this species, the original figured specimen of Dr. Maury from the Miocene of Santo Domingo.

Gatun Stage: Water Cay.

Cancellaria epistomifera Guppy

Cancellaria Moorei Gabb. 1872, Trans. Amer. Phil. Soc., vol. 15, p. 236. Not *C. Moorei* Guppy, 1866.

Cancellaria epistomifera Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 32, p. 520, pl. 28, fig. 9.

Cancellaria epistomifera Cossmann, 1913, Journ. de Conchyliologie, vol. 61, p. 53, pl. 4, figs. 5, 6.

Cancellaria epistomifera Maury, 1917, Bull. Amer. Pal., vol. 5, p. 227, pl. 10, figs. 3, 4, 5.

For figures of this species, the reader is referred to Dr. Maury's Dominican Fossils. We have collected a few, small and imperfect specimens at Gatun in the Canal Zone. Small shells are easily confused with the common *C. dariena*, but in general the spire is shorter, and the spiral sculpture is heavier and more regular. At maturity, the outer lip develops below a peculiar and characteristic sulcus or pout, which is not seen on any of the associated species of *Cancellaria*.

Gatun Stage: Gatun, C. Z.

Cancellaria Rowelli Dall Plate 6, figure 7

Cancellaria Rowelli Dall, 1898, Proc. Acad. Nat. Sci. Phila., vol. 19, p. 307, pl. 29, fig. 1.

Cancellaria Rowelli Maury, 1917, Bull. Amer. Pal., vol. 5, p. 227, pl. 16, fig. 2

Two specimens of a *Cancellaria* which seem to be this species, were collected from the Gatun beds of East Grape Point Creek. The axial ribs are numerous, oblique and somewhat irregular. The spaces between the ribs are finely spiralled with deep, incised lines, producing narrow and regular spiral bands. The columellar plications are large and more or less bifid. Shell measures:

Length 30, diameter 18, last whorl 21 mm.

The Cornell Museum contains, in the Gabb collection, a single specimen which is probably this species. It agrees with the Costa Rican shells. This species was described by Dall from the Miocene of the Rio Amina, Santo Domingo.

Gatun Stage: Collection 2, East Grape Creek, C. R.

Subgenus **TRIGONOSTOMA** Blainville

Cancellaria toroensis, n. sp. Plate 6, figure 4

Cancellaria (*Trigonostoma*) aff. *Cancellaria bullata* Sowerby, Toula, 1911, Jahrb. der K-K. Geol. Reichsanstalt, vol. 61, p. 504, pl. 30, fig. 10.

Shell with 6 large, expanding whorls; the nucleus of 2½ whorls is small, closely coiled and smooth; the succeeding 2 post-nuclear whorls are small, convex and finely reticulated with 6 spirals and fine ribs; the last two whorls are deeply channeled or excavated along the suture; this excavated band is smooth, except as crossed by oblique growth lines; the last whorl is somewhat contracted above and between this contracted zone and the sutural channel is a large, heavy, more or less bifid spiral cord. This spiral cord is rendered coarsely and sharply nodulose by the axial sculpture; the sculpture consists of about 21, narrow, low, oblique riblets crossed by strong spiral cords; the spirals are rendered slightly nodulose by the crossing of the longitudinal ribs the penultimate whorl shows 6 or 7 spirals and 14 or 15 on the last whorl; the contracted band around the upper part of the whorl is nearly free from spirals, but is bordered above as already noted by the large, bifid and strongly nodulose spiral cord; base deeply but narrowly umbilicate, spirally sculptured within; columella with 3, oblique plications; inner lip with a wide callus, finely pustulated; the outer lip is broken in the type.

Length 29, diameter 20, last whorl 23 mm.

This is the Miocene analogue of the recent West Coast *C. tuberculosa* Sowerby. It is probably the species figured by Toula from the Canal Zone and which he compared with *C. bullata* Sowerby. More recently Pilsbry and Johnson have described as *C. insularis*, a *Trigonostoma* from the Miocene of Santo Domingo and which they consider as possibly identical with Toula's Isthmian specimen. In their description they mention but 14 ribs while *toroensis* has 21 and they relate their species with the Chesapeake Miocene *perspectiva* Conrad and the Tampa *depressa* Dall, species which belong to an entirely different group.

Gatun Stage:

Toro Cays, Providence of Bocas del Toro, Panama.

Cancellaria Plummeri, n. sp. Plate 6, figures 2, 3

Shell thin and delicate, with large, loosely coiled whorls; the whorls are prominently shouldered and deeply channeled or excavated along their upper sutures; nucleus of three small, smooth whorls; post-nuclear whorls 4; the sculpture consists of very fine and delicate spiral threads or lines and three rows of slightly elevated spine-like elevations or small tubercles; the larger of these rows is found along the shoulder of the whorls bordering the excavated zone, a smaller on the middle and a small scarcely noticeable one below; on the penultimate whorl, only two rows show and on the upper spire-whorls but one; the umbilicus is deep, but narrow; the interior is concealed in the matrix.

Height 34, diameter 26, last whorl 17, aperture 19 mm.

This is a very distinctive species, characterized by its thin, delicate shell and fine sculpture. It may be compared with the recent *T. bullata* Sowerby from the Pacific coast of Central America, which differs in its larger, more expansive body-whorl and coarser sculpture. The single specimen was collected from the lower part of the Gatun formation on Toro Cays, in the eastern part of the Chiriqui Lagoon.

It is named for Mr. Fred Plummer of the Royal Dutch Oil Company of Hague, Holland.

Gatun Stage: Toro Cays.

Subgenus **APHERA** H. and A. Adams

Cancellaria islacolonis Maury Plate 6, figure 12

Cancellaria tessellata Gabb, 1873, Trans. Amer. Phil. Soc. vol. 15, p, 236. Not of Sowerby, 1832.

Cancellaria islacolonis Maury, 1917, Bull. Amer. Pal., vol. 5, p. 229. pl. 10, figs. 12, a, b.

The *C. islacolonis* was selected by Dr. Maury, as the guide fossil for the lower of her Miocene formations, the Cercado. It is a very rare fossil in Costa Rica and we have collected it only along Red Cliff Creek, in the eastern part of the Republic. There it occurs in the upper part of the Uscari and in the lower part of the Gatun.

It is closly related to the recent West Coast *C. tesselata* Sowerby.

Uscari formation; Coll. 6, Red Cliff Creek.
Gatun formation; Coll. 4, Red Cliff Creek.

(*B*) *SUPER-FAMILY RHACHIGLOSSA*

Genus **OLIVA** Bruguiere

Olives are among the most common fossils in the Miocene beds of Panama and Costa Rica. The various species, however show so few distinguishing characters, that their identification becomes at times, both difficult and uncertain. The following key has been prepared showing the characters which have been most relied upon for their separation. This key should be used in conjunction with the figures.

A. Aperture narrow and of about the same width along its whole length. Inner lip finely and regularly crenulated above.

  B. Sutures deep or channelled, with the edge of the whorl projecting slightly above; spire of medium height, length 35 mm.

  O. sayana var. *immortua* Pilsbry & Brown

  BB. Sutures not channelled and with the upper edge of the whorl beveled or appressed.

    C. Spire generally low, with concave profile and usually a projecting and globular nucleus. Length 35 mm. *O. brevispira* Gabb

    CC. Spire high or short, with conic sides; nucleus or protoconch not large or prominent.

      D. Spire high and conic; shell large. Length 40 mm or more

      O. cylindrica Sowerby

      DD. Spire short, shell usually small. Length rarely over 30 mm.

      O. gatunensis Toula

AA. Aperture wide and usually expanded and flaring in front; inner lip is not crenulated above. (*Agaronia*)

  B. Spire long, about 1-3 of the length of the shell;

inner lip not strongly calloused. Lenght up to 45 mm. *O. mancinella*, n. sp.

BB. Spire shorter, about 1-4 of the length of the shell; inner lip usually strongly callused. Length about 40 mm.
O. testacea var. *costaricensis*, n. var.

Oliva cylindrica Sowerby — Plate 7, figure 1

Oliva cylindrica Sowerby, 1849, Quart Jour. Geol. Soc. London, vol. 6, p. 45.

Oliva reticularis Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p. 288,. Not of Lamarck.

Oliva cylindrica Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 215.

Oliva cylindrica Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 32, p. 526.

Oliva cylindrica Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1583.

Oliva cylindrica Cossmann, 1913, Journ. de Conchyliologie, vol. 61, p. 57, pl. 5, figs. 2, 3.

Oliva cylindrica Maury, Bull. Amer. Pal., vol. 5, p. 231, pl. 10, figs. 14, 14a.

A single, large specimen from Costa Rica, is doubtfully referred to this Dominican Miocene fossil. It differs from the more common *brevispira* by its larger size and longer, more conic spire. This shell is also closely related to the recent *O. araneosa* Lamarck of the West Coast.

Length 47, diameter 19 mm.

Gatun Stage: Upper Gatun beds, 1 mile south of shore, along Old Man Sam Creek, C. R.

Oliva brevispira Gabb — Plate 7, figures 2, 3, 4

Oliva brevispira Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 215.

Oliva brevispira Maury, 1917, Bull. Amer. Pal., vol. 5 p. 232, pl. 10, figs. 16, 17.

variety *Giraudi* Cossmann

Oliva Giraudi Cossmann, 1913, Journ. de Conchyliologie, vol. 61, p. 56, pl. 5, figs. 4-8.

A fairly common species in Cost Rica. Typically the shell is short; moderatly convex, a short projecting spire and concave spire-whorls.

Unusually broad forms as illustrated by figure 4 may be separated by the name of *Giraudi* Cossmann.

A large typical shell measures:
Length 35, diameter 17 mm.

Gatun Stage: Coll.6, Red Cliff Creek, C. R.
Headwaters of Middle Creek, C. R.
Coll. 5, Grape Point Creek, C. R.

Oliva gatunensis Toula Plate 7, figure 5

Oliva gatunensis Toula, 1909, Jahrb. der K-K. Geol. Reicesanstaldt, vol. 58, p. 702, pl. 25, fig. 12.

Oliva reticularis gatunensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 348.

Oliva gatunensis Cossmann, 1913, Jour. de Conchyliologie, vol. 61, p. 58, pl. 5, figs. 9-12.

A common species at Gatun. The largest specimen in our collection measures 28 mm. in length but Brown and Pilsbry mention shells of an length of 35-38 mm. *Oliva gatunensis*, resembles somewhat the *brevirsoira* of Gabb, but has a more even conic spire and lacks the projecting nuclear tip. The sutures are appressed. Brown and Pilsbry, place this shell as a variety of the larger, recent *Oliva reticularis* Lamarck.

Gatun Stage: Mt. Hope, C. Z.

Oliva sayana var. immortua Pilsbry and Brown Plate 7, figs. 6, 7

Oliva sayana var. *immortua* Pilsbry and Brown, 1917, Proc. Acad. Nat. Sci. Phila., p. 33, pl. 5, fig. 6.

The *Oliva sayana* Ravenel (*Oliva literata* of most writers) is a common recent species along the eastern coast of United States, becoming replaced in the West Indies by the *Oliva reticularis* Lamarck. These two species are principally distinguished from each other, in that the sutures of *O. sayana* are quite deeply channelled, above which projects the upper edge of the whorls while in *reticularis* the sutures are merely deep with rounded or beveled shell margins.

O. sayana var. *immortua* was described by Pilsbry and Brown, from Gatun beds in the vicinity of Cartagena, Columbia. What appears to be the same shell is common in the exposures found along the lower part of the Banana River. Like the *brevistria* it is rather darkly colored, but no trace of a pattern is preserved. Our specimens averaged in length about 36 mm. The largest specimen measures 41 by 19.5 mm.

Gatun Stage: Banana River, C. R.

Oliva testacea Lamarck, var. **costaricensis**, n. var. Plate 7, figs. 12, 13

Shell rather solid, with a moderately projecting spire, about 1-4 or less of the total length of the shell; whorls about 5, the last, large, convex and widest about the middle; the spire-whorls appear as if mesially divided by an encircling weak callus about the lower half; aperture broadest below, with the inner lip heavily calloused above near its junction with the outer; the inner lip is non-denticulated above, along its lower part with 3 or more, irregular oblique, plaits; a broad band, arises from about the middle of the inner lip, passes obliquely downward over the back of the shell to the lower end of the outer lip.

Length 42, diameter 19 mm.

This Oliva is abundant in the Gatun beds of the Banana River, C. R. It is closely related to the recent *O. testacea* Lamarck but seems to differ in being wider, shorter and with a lower spire.

The *Oliva testacea* Lamarck (in part *O. hiatula* of some authors) is abundant along the Pacific coast of Panama, and in the Manuals, its range is given as the West Coast. Recently a closely related if not identical form, was collected by us from the Pleistocene at Almirante, Panama, and several broken specimens from the beaches at Bocas del Toro, Panama, and from Manzanilla, C. R. This recent Atlantic form differs only from the typical West Coast *testacea* in being somewhat more slender and apparently differently colored.

Tryon in the Manual of Conchology unites *testacea* with *hiatula* Gmelin from West Africa.

Gatun Stage: Banana River, Coll. 5, 6, of Red Cliff Creek, C. R.

Oliva mancinella, n. sp. Plate 7, figures 8, 9

Shell slender and more delicate than the preceding; spire long and pointed and about 1-3 of the total length of the shell; 5 whorls; sutures deep; the spire-whorls have their lower half thickened by a smooth, encircling band of callus; aperture broadest about the lower half; inner lip smooth above, with only a small and weak callus at its junction with the outer lip; the outer lip carries below, 3 or 4 heavy and very oblique plaite; the outer lip is smooth and sharp.

Length 48, diameter 11 mm.

This species differs from *O. testacea* and its variety *costaricensis* by its much more slender and delicate shell. The porportions of the spire are about 1-3 of the total length of the shell.

Gatun Stage: Coll. 4, East Grape Point, Creek, C. R.

Genus **OLIVELLA** Swainson

A. Shell large, length 20 mm. or more; spire long and about ½ the total length of the shell.

Olivella goliath, n. sp.

AA. Shell smaller; spire long or short, usually less than ½ of the total length.

B. Shell short and stubby, spire rather short,

bluntly pointed; 1-3 or less the total length.
Olivella limonensis and variety *bocasensis*, n. sp. and var.

BB. Shell with a longer spire, often sharply pointed.

C. Shell rather broad, with a heavy callus about the upper part of the inner lip and extending partly over the penultimate whorl. Length 12 mm. plus.
Olivella muticoides Gabb.

CC. Shell slender, with a long, pointed spire; callus about the upper of the inner lip, slight.
Olivella Boussaci Cossmann, var.

Olivella goliath, n. sp. Plate 7, figures 22, 23

Shell large, with a long, pointed spire of about ½ of the total length of the shell; whorls about 6, with plain, nearly straight profile; sutures linear; last whorl with the greatest convexity about the middle; aperture subelliptical, broadest in front; inner lip with a thin, flat callus and with 3 small plaits below.

Length	diameter	last whorl	spire
26,	10,	20,	13 mm
23	8.5	18	12 mm

An unusually large species, represented by two specimens from Red Cliff Creek and Banana River. Its general form is that of *O. indevisa* Guppy and *O. Boussaci* Cossmann, but nearly 4 times as large.

Gatun Stage: Banana River.
Coll. 5, Red Cliff Creek, C. R.

Olivella muticoides Gabb Plate 7, figures 11, 14, 17, 18

Oliva muticoides Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 215.

Olivella mutica variety *muticoides* Dall, 1890, Tarns. Wagner Free, Inst. Sci., vol. 3, pt. 1, p. 45.

Olivella muticoides Maury, 1917, Bull. Amer. Pal., vol. 5, p. 232, pl. 11, fig. 1.

A broad, chubby species with a spire of moderate length. A large, thick callus is formed about the upper part of the inner lip, which spreads partly over the back of the penultimate whorl, giving to it a hump-back appearance. Measurements of our Costa Rican shell run as follows:

Length 17,	diameter 7,	last whorl 14,	spire 6.5 mm.
13	6.5	11	5.5 mm.

Gatun Stage: Coll. 5, Red Cliff Creek.
Coll. 4, East Grape Point Creek.

Olivella Boussaci Cossmann, variety Plate 7, figures 15, 16

Olivella Boussaci Cossmann, 1913, Journ. de Conchyliologie, vol. 61, p. 60, pl. 5, figs. 16-19.

The *Olivella indivisa* Guppy (Proc. U. S. Nat. Mus., vol. 19, p. 308, pl. 30, fig. 10) from Jamaica and *Olivella Boussaci* Cossmann from Martinique, belong to a closely related series characterized by their high and sharply pointed spire. The main difference seems to be that of size. The *indivisa* has a length of 6.5 mm., the *Boussaci* of 9 mm. The Costa Rican shells are generally larger and when full-grown, often 13 or more mm. in length.

Often very common.

Length 13, diameter 5, last whorl 10, spire 6.5 mm (6 whorls)

Gatun Stage: Hill 1a, Banana River.
Hill 3, Banana River.

Olivella limonensis, n. sp. Plate 7, figures 19, 20

Shell short and plump, with a small, broad, conic spire; whorls about 5, separated by deep sutures; last whorl very large, broadly cylindrical in form and slightly contracted in the middle; the inner lip has a wide callus, somewhat heavier above, with 5 fine, denticles in the middle and few, more oblique plaits below; the base is obliquely encircled by a lighter colored band; outer lip sharp, smooth within.

Length 10.5, diameter 4.75, last whorl 9, spire 2.25 mm.

This is a common shell in the coralline phase of the Gatun at Port Limon. The middle of the last whorl is usually dark colored, with the spire and the encircling basal band and callus on the inner lip white.

Gatun Stage: Port Limon.

Olivella limonensis var. **bocasensis,** n. var. Plate 7, figures 24, 25

A much smaller shell than the *limonensis* and possibly a distinct species. The spire is somewhat higher and the shell less cylindrical and pump. Dimensions as follows:

Length 6.5, diameter 2.75, last whorl 6, spire 1.5 mm.
7, 3.25, 6.5 1.75 mm.

Gatun Stage: Bocas del Toro, Panama.

Genus **ANCILLARIA** Lamarck

Ancillaria aquaensis, n. sp. Plate 7, figure 10

Shell of medium size, solid; spire elevated, composed of about 5 whorls, the sutures of which are concealed by a wide band of callus this band of callus commences on the body-whorl, a short distance below the suture, and extends to the apex; where this band covers the sutures, it forms just above, a depressed or constricted band on the middle of each whorl; the last whorl is large, with a basal band of callus, which commences near the upper end of the inner lip, descends obliquely across the back of the last whorl to the anterior tips of the outer and inner lips; a short distance above this basal band, the shell carries a single, incised line; a small umbilical pit is found just behind the middle part of the inner lip; aperture broadly sub-elliptical with a sharp outer lip.

Length 18.5, diameter 7.5, last whorl 12.5, spire 10 mm.

The *Ancillaria pinguis* Guppy, from Jamaica is probably a closely related species. Guppy's figure in the Geological Magazine, vol. 1, Decade 2, is very poor and insufficient. Our shell seems to differ by its much longer spire and more slender shell.

The *Ancillaria chipolana* Dall, figured on Plate 41, fig. 3, of the Wagner Institute, is larger and has a longer spire. No umbilical pit is shown in the figure.

Gatun Stage: Water Cay, (Isla de Aqua).

Genus **MARGINELLA** Lamarck

Marginella MacDonaldi Dall Plate 6, figures 14, 15, 17, 19

Marginella MacDonaldi Dall, 1912, Smith, Misc. Coll., vol. 59, No. 2, p. 7.

This large *Marginella* is one of the most common and characteristic species of the Gatun beds of Costa Rica. It is extremely valiable in size and general from and heaviness of its shell, as may be seen in the accompanying figures of the more common varieties.

Typically the shell is oblong-cylindrical with a small spire of about 4 whorls, usually completely covered in front by a broad mass of callus, which spreads over the whole base of the shell and the outer lip, leaving an elevated ridge along each side as frequently seen in *Cypræa*. From the back, the spire may be seen lying in the mass of callus.

The *Marginella mindiensis* Cossmann is a smaller related species from the Canal Zone. It differs also in having its outer lip finely denticulated, while in *MacDonaldi* the outer lip is usually smooth.

Length	diameter of base	vertical diameter
28,	15,	10 mm.
24	14	9 mm.
25	13	9.5 mm.
17.5	11	7.5 mm.

Gatun Stage: Banana River.

Marginella mindiensis Cossmann Plate 6, figures 16, 23

Marginella mindiensis Cossmann, 1913, Journ. de Conchyliologie, vol. 61, p. 61, pl. 5, figs. 13-15.

This shell is very closely related to *M. MacDonaldi.* It differs only in being smaller and usually with the outer lip more or less denticulated. The outer lip of *M. MacDonaldi* is generally smooth but occasional specimens occur in which the outer lip is faintly denticulated. It is a species of the Canal Zone.

Length 19.5;	basal diameter 11,	vertical diameter 8 mm.
16	9	7 mm.

Gatun Stage: Mindi, (*Cossmann*)
Gatun, C. Z.

Marginella latissima Dall

Marginella latissima Dall, 1896, Prac. U. S. Nat. Mus., vol. 19, p. 308, pl. 29, fig. 11.

This is a short and very broad species, described by Dall from Moen Hill, C. R. Dall remarks: "This is perhaps the shortest and widest American species."

Length 11, diameter 8.5 mm.

Gatun Stage: Moen, Costa Rica, (*Gabb*).

Marginella latissima, var. **pilsbryi**, n. var. Plate 10, figures 1, 2

Marginella coniformis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 348, pl. 24, fig. 12. Not of Sowerby, 1849.

Like *M. latissima* Dall, but less broad, more pointed anteriorly, a slightly higher spire and a less heavy outer lip. In *latissima*, the two posterior plications are shown as being very oblique, while in the present form they are nearly transverse as is seen in the recent *cincta*. The outer lip is finely granulated.

Length 14,	basal diameter 9.5,	vertical diameter 6.75 mm.
15	11	9 mm.

This shell is figured as the *Marginella coniformis* Sowerby a common Dominican fossil, by Brown and Pilsbry. The *Marg-*

inella coniformis has been figured by Guppy in the Quarterly Journal and similiar shells were collected in abundance by the Maury expedition to Santo Domingo. It is a larger and more cylindrical form.

It is an abundant shell in the quarries west of the Gatun locks at Gatun. A single, large shell figured as figure 1 was collected from the Banana River beds.

Gatun Stage: Gatun, C. Z.
Banana River, C. R.

Marginella avena Valenciennes Plate 7, figures, 21, 28

Marginella avena Valenciennes, 1814, in Kiener, Coq. Viv. *Marginella*, p. 17, pl. 6, fig. 24.

Marginella avena Gabb, 1881, Journ. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 355.

A common, recent species along the Caribbean coast of Panama and Costa Rica. As a fossil, it occurs plentifully in the coralline phase of the Gatun at Port Limon and Bocas del Toro. The fossil shells do not differ materially from their recent representative.

The shell is elongate-cylindrical in outline, with a low, but slightly projecting spire. The aperture is norrowly linear, slightly wider in front. Outer lip thick, smooth within. The columella is provided with 4, obliquely descending plications.

A series of specimens from Limon and Bocas measure as follows.

Length 11.75,	diameter 4.25,	spire 2.
11.50	4.25	1.5,
12.50	4.50	2.

Gatun Stage: Port Limon, C. R.
Bocas del Toro, Panama.
Coll. 4, Red Cliff Greek.

Marginalla collina, n. sp. Plate 7, figures 26, 27

Shell of the general form and size of *M. avena*; but more solid and with a lower and less differentiated spire; whorls 4 or more with sutures scarcely distinguishable under their glaze or coat of callus; aperture linear-elongate, widest in front and slightly contracted in the middle; outer lip thickened, smooth within; pillar with 4, oblique plaits of nearly equal strength.

Length	diameter	spire
11,	4.5,	1.5 mm.
10	4.25	1 mm.
11.25	5.	1 mm.

Closely related to the *Marginella avena* Val., this species differs in being more solid, less slender and with a lower spire. In *avena* the spire is clearly differentiated, with well marked sutures to its spire-whorls. In the present shell, the spire is much lower, and the sutures are more thickly covered with glaze. The thick outer lip is carried across the end of the lip and firmly joined to the spire without any preciptible line of demarcation. In *avena*, the outer lip and spire are clearly differentiated from each other.

Abundant in the Gatun beds of the Banana River.

Gatun Stage: Hill 1a, Banana River.

Marginella leander Brown and Pilsbry Plate 6, figure 22

Marginella leander Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 347, pl. 24, fig. 13.

Not known from Costa Rica, and the figure here given is from a specimen in our collection from Gatun. It is a broader and more cylindrical species than *collina*, and with a much lower and scarcely elevated spire. Our specimen measures 9 by 4 mm.

Gatun Stage: Gatun, C. R.

Marginella musacina, n. sp. Plate 10, figure 25

Shell small and slender, with a high spire of about 1-4 of the total length of the shell; whorls about 5, with sutures lightly concealed under a thin coat of glaze; last whorl narrowly cylindrical, widest about the upper half; aperture sublinear, with a slightly thickened lip, somewhat contracted in the middle, smooth within; inner lip smooth, or with only a thin wash of callus and with 4, very oblique plications at its extreme anterior end.

Length 9.25, diameter 3.25, spire 2.75 mm.

A small, slender species of unusual form. Two specimens were collected in Costa Rica, the type from the Banana River, the other from Old Man Sam Creek, near Manzanilla Point.

Gatun Stage: Banana River,
Along Old Man Sam Creek, one mile south of the beach, C. R.

Genus **VOLUTA** Linnæus

Voluta alfaroi Dall Plate 8, figure 2

Voluta alfaroi 1912, Smith, Misc. Coll., vol. 59, No. 2, p. 8.

This fine species described by Dr. Dall, from the Banana River, is a common and very characteristic fossil or the Gatun beds in Costa Rica and Western Panama, but it still remains to be recorded from the Canal Zone. Allied to the recent West Indian *V. musica* Linnæus it differs most importantly in its much smaller nucleus.

The shell is heavy and in its typical form the whorls are shouldered and carry about 12 ribs, which may be quite sharp and high on the shoulder angle. The whorls are sometimes smooth, without ribs and a shoulded angle. Spiral threads usually occur on the lower one-quarter of the last whorl and on the canal, but in some cases on the spire-whorls as well. A large specimen from Water Cay measures;

Height 59 mm. diameter 34 mm.

Gatun Stage: Water Cay Panama.
Coll. 3, Red Cliff Creek; Old Man Sam Creek, 1 mile from shore; Coll. 2, Quitana Creek; Comadre Creek; Sousi creek; Coll. 5, Estrella River; Banana River; Rio Blanco; Port Limon.

Genus SCAPHELLA Swainson

Scaphella costaricana, n. sp. Plate 15, figure 13

Type fragmentary consisting of the nucleus and part of the three succeeding whorls; the shell is subfusiform; nucleus large, smooth and mammilate at its apex; the three following whorls are slightly contracted about the upper sutures and strongly sculptured with coarse subregular, spiral threads separated by interspaces as wide or a little more: the spiral threads and their interspaces are crossed by fine lines of growth; sutures distinct; the columella with four plaits, the posterior one being the strongest.

Length 29, diameter 18, diameter of nucleus 5.75 mm.

The unique type is unfortunately fragmentary and consists of the large, smooth, mammilate nucleus and part of the 3 succeeding whorls. The shell is subfusiform and the whole surface is strongly sculptured with coarse, spiral threads. The columella is provided with 4 strong plaits. The type specimen was found in the *Dentalium* zone of the Upper Uscari shales of Cocles Creek.

Uscari Stage: Cocles Creek.

Genus MITRA Lamarck

Mitra Swainsoni Broderip, var. **limonensis,** n. var. Plate 6, fig. 1.

cf. *Mitra Swainsoni* Roderip, 1835, Proc. Zool. Soc., p. 193.

cf. *Mitra Swainsoni* Reeve, Conch. Icon., *Mitra*, pl. 1, fig. 4.

cf. *Mitra Swainsoni*, var. *antillensis* Dall, 1889, Bull. Mus. Comp. Zool., vol. 18, p. 158, pl. 38, fig. 7.

Shell large, of about 6+ whorls; the spire whorls are slightly convex, the last distinctly shouldered above, depressed or slightly concave about its middle; sculpture consisting on the spire-whorls of about 6, heavy, spirals cords with sculptured interspace as seen on *Mitra Henekeni* and *longa;* on the later whorls the spiral cords become more widely spaced and on the last are in the form of broad, subobsolete, smooth bands without the sculptured interspaces; there are about 15 spiral cords on the last whorl in addition to those of the anterior canal; anterior canal of moderate length, strongly twisted; columella with 4 plaits, heaviest above; aperture narrow.

Length 74 (apex broken), diameter 23, last whorl 52, spire 35 mm.

A single, large shell with rudely sculptured whorls was collected from the coralline limestone near Port Limon. It agrees closely with Reeve's figure of *Mitra Swainsoni*, except that the spiral bands are larger and heavier.

The *Mitra Swainsoni* is a West Coast shell belonging to the Panamic province. It is distinguished by its large size, rudely sculptured whorls and dark colored epidermis. Dall has described as the variety *antillensis*, specimens dredged off of Cape Lookout, N. C., Colombia and Yucatan.

Gatun Stage: Port Limon.

Mitra longa Gabb Plate 6, figure 10

Mitra longa Gabb, 1873. Trans. Amer. Phil. Soc., vol. 15, p. 219.

Mitra longa Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 346, pl. 24, fig. 11.

Mitra longa Maury, 1917, Bull. Amer. Pal., vol. 5, p. 238, pl. 11, figs. 11, 11a.

A long, slender species, sculptured with strong, revolving cords and fine, neatly engraved interspaces. We have collected this Dominican species only in the Canal Zone. The figured specimen has the following dimensions:

Length 40, diameter 10.5, last whorl 26, spire 21 mm.

Gatun Stage: Gatun, C. Z.

Mitra dariensis Brown ond Pilsbry Plate 6, figure 25

Mitra dariensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 60, p. 346, pl. 24, fig. 11.

A single specimen from the Island of Bocas (Columbus or Colon Island) is here figured. It differs from the *Mitra longa*, in being shorter and broader. The sculpture is less elegant.

Length 21, diameter 7, last whorl 14, spire 11 mm.

Gatun Stage: Gatun, C. Z.
Bocas del Toro, Panama.

Mitra aff. **rudis** Gabb Plate 6, figure 13

Mitra rudis Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 220.

Shell subfusiform, biconic; whorls about 7, coarsely sculptured with strong, revolving cords, separated by interspaces of about twice their width; These interspaces are finely longitudinally sculptured with raised threads above, obsoletely so below; the spire-whorls have 5 cords, the last whorl with 11 and several smaller ones on the canal; aperture subelliptical, with a thin outer lip; columella with 4 plaits, largest above; anterior canal of medium length, strongly twisted below.

Length 33.5, diameter 12.5, last whorl 24, spire 16 mm.

It is with much uncertainty, that I have identified this rare species with Gabb's unfigured *Mitra rudis* from Santo Domingo. Gabb,s descriptions and measurements indicate a shell of much the same characters as well as dimensions.

Gatun Stage: Coll. 3, Hone Walk Creek, C. R.

Mitra poas, n. sp. Plate 6, figures 20, 21

Shell small, nearly smooth and columbelloid in appearance; whorls 8, with straight sides; last whorl widest just above the base, which is contracted to the short anterior canal; the early spire-whorls have 5, low, smoothish spiral bands, with longitudinally sculptured, narrow interspaces; these spirals quickly become obsolete, leaving the whorls smooth except for one or two spirals bordering the upper sutures; the last whorl has about 4 spirals around the base and smaller ones on the canal; aperture subellipical, with a thin outer lip; columella with 4 plaits, largest above; anterior canal of medium length and slightly bent to the left

Length 21, diameter 7.5, last whorl 13, spire 11 mm.

A smooth species of Columbelloid aspect. It is fairly abundant in the coral limestones near Port Limon.

Gatun Stage: Port Limon,

Mitra Almagrensis Toula var. **coralliophila,** n. var. Plate 6, figures 18, 24

of *Mitra Almagrensis* Toula, 1911, Jahrb. der K-K Geol. Reichsanstalt, vol. 61, p. 491, pl. 28, fig 13.

Shell small with a long spire and a shorter anterior canal; whorls about 8, with straight or slightly convex profile; sculpture of low, slightly elevated spiral cords, separated by interspaces of about their own width; these interspaces are finely sculptured by regular, raised, longitudinal threads; the spire-whorls have about 5 spiral cords, the last whorl with about 15; and smaller ones on the anterior canal; aperture subelliptical; a short canal, slightly bent to the left; pillar with 3 folds and a very small faint one below.

Length 17, diameter 6, last whorl 11, spire 10 mm.

This is a common species in the coral limestones of Limon. Toula's *Mitra Almagrensis* was described from Tehuantepec. Our shells differ from Toula's figure in being more slender and in having the body-whorl less contracted below.

Gatun Stage: Port Limon.

Genus **FUSUS** Lamarck

Fuscs miocosmius, n. sp. Plate 8, figure 5

Shell long and slender, with the spire and canal of nearly equal length; whorls about 11 plus, very gradually tapering from the small nucleus to the body-whorl; whorls convex with indistinct, appressed sutures; the sculpture consists of large, swollen ribs, separated by equally wide interspaces, and the whole crossed by strong spirals with finer threads in between; on the last whorl there are 7 ribs, which commence on the base, just above its union with the long canal, and continue across the whorl to the suture; the early spire-whorls have 6 or 7 strong spirals with 1, 2 or 3, fine threads between; on the penultimate whorl, the earlier spirals have become a primary set of 6 or 7, with their intervals occupied by a secondary set, nearly as large as the primary, and still smaller tertiary threads; the last whorl has about 18 strong spirals in addition to those on the canal; on the canal the division into primary and secondary spirals is better shown, there being about 16 primary and the same number of secondary spirals; on the extreme tip of the canal the spirals are very small and numerous; aperture small, rounded, with the outer lip internally lirated and three or more oblique plaits on the columella.

Height 100, diameter 24 mm.

This fine species is closely related to the recent *Fusus eucosmius* Dall, from the Florida coast and the West Indies. The spire of *eucosmius* is more slender, has 8 ribs instead of 7, and the outer lip is always smooth, while it is strongly lirated in *miocosmius.*

Gatun Stage: Bocas del Toro, Panama.

Fusus honensis, n. sp. Plate 8, figure 6

Shell resembling in general features the *F. miocosmius*, and with the same number of ribs; the spire is somewhat longer than the anterior canal; the whorls are somewhat more convex than those of *miocosmius* due to the more strongly knobbed ribs; the ribs are crossed on the penultimate whorl by about 6, strong, even spirals, there being no secondaries and only occasionally a small thread may appear in their intervals; the last whorl, exclusive of the canal shows 10 or 11 spirals to which are added 17 or 18 on the canal; the canal is relatively short and not perfectly straight; the aperture is probably rounded (largely broken on the type specimen) and with its outer lip internally lirated.

Height 63, diameter 20 mm.

Similiar in general form and in the number of its ribs to the *F. miocosmius* from Bocas, this species differs in its smaller, heavier shell, and in the greater coarseness of its sculpture. The spirals are heavier and primary in character throughout and the ribs are more knobbed and sharp on their crests. From the Dominican *F. Henekeni* Sowerby, it differs in being much more slender and with fewer, persistent ribs.

Gatun Stage: Coll. 4, Home Walk Creek.

Genus **FASCIOLARIA** Lamarck

Fasciolaria Gorgasiana Brown and Pilsbry Plate 8, figure 9

Fasciolaria gorgasiana Brown and Pilsbry, 1912, Proc. Acad. Nat. Sci. Philia., vol. 64, p. 506, pl. 22, fig. 5.

This large *Fasciolaria* is fairly abundant in the Gatun beds of the Canal Zone and is recognized by its shouldered whorls and and strong knob-like ribs. The figured specimen is a large shell from the Gatun of Rio Betey, Costa Rica.

Gatun Stage: Gatun, C. Z.
Water Cay.
Rio Betey.

Fasciolaria tulipa Linnæus, variety Plate 13, figure 4

Murex tulipa Linnæus, 1758, Syst. Nat.,ed. 10, p. 754.

Fasciolaria tulipa Gabb, 1881, Journ. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 354.

Fasciolaria tulipa Dall, 1890, Trans. Wagner Free Inst. Sci., vol. 3, pt. 1, p. 101, pl. 7 fig. 11

The Tulip shell is the common, recent *Fasciolaria*, in the Caribbean area, and it is distinguished from its more northern relative, the *distans*, by its darker coloration and sulcated sutural. band. It occurs as fossil in the Pliocene of Florida.

From the coralline limestones, near Port Limon we collected three young specimens and a portion of the spire of a large individual of *Fasciolaria*. The young shells show the nucleus and early sulcated whorls of typical *tulipa*, as fignred by Dr. Dall. They however become smooth somewhat earlier and the fragment of the spire shows the succeeding whorls to be smooth and lacking the sulcated sutural band as in *distans*.

The *Fasciolaria semistriata* Sowerby is an allied but distinct species from the Miocene of Santo Domingo, and likely to be discovered in the Gatun beds of Costa Rica and Panama. This as may be seen from the new figure of Dr. Maury, (Bull. Amer. Pal., vol. 5, p. 244, pl. 13, fig. 1), differs conspicuously from the *distans* and *tulipa*, with which it was united by Gabb, by its deep sutural depressed band, which gives to the whorls, a very convex or even shouldered appearance. The early whorls are spirally sulcated as in *tulipa*, but have in addition knob-like ribs, like those seen on *F. gorgasiana*.

Uscari Stage: Port Limon.

Fasciolaria MacDonaldi, n. sp. Plate 8, figure 1

Shell large, (type specimen imperfect, with only the last two whorls preserved); number of whorls unknown; the spire-whorls are angled about the middle, forming a board, sloping shoulder above; the last whorl has the shoulder about the upper third; the sculpture is predominantly spiral, consisting of numerous, fine, alternating threads, which are slightly roughened by the growth lines; the angle of each whorl is longitudinally undulated by 12 faint ribs; anterior canal is nearly straight with two faint plicæ; outer lip sharp.

Length (2 whorls) 70, diameter 37 mm.

Of this large and elegant species, only a single imperfect specimen with less than two complete whorls preserved, was collected from the Gatun beds of the Banana River, Costa Rica. It differs from the more common *F. Gorgasiana*, by its persistent and rough spiral sculpture and less heavily tuberculated shoulder.

This species is named in honor of Dr. D. F. MacDonald, well-known for his geologic work on the Isthmus, during the construction of the Panana Canal, and former Chief Geologist of the geological force of the Sinclair Oil Corporation in Panana and Costa Rica.

Gatun Stage: Hill No. 2, Banana River.

Genus **LATIRUS** Montfort

Latirus infundibulum Gmelin, variety Plate 8, figure 10

Latirus infundibulum Gmelin, Lamarck, Anim. sans, Vert. (ed, Desh.) vol. 9, p. 386.

Latirus infundibulum Guppy, 1866, Quart. Journ. Geol. Soc. Loudon, vol. 22, p. 288.

Latirus infundibulum Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 217.

Latirus infundibulum Gabb, 1881, Journ. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 354.

Latirus infundibulum Maury, 1917, Bull. Amer. Pal., vol. 5, p. 246, pl. 13, fig. 3

A common recent species of the West Indian and Costa Rican coasts. Only an imperfent specimen was collected from the Gatun beds of lower Pumbri Creek, a small tributary of the Estrella River. From recent examples of *infundibulum*, it differs by its shorter canal, more numerous ribs (9 instead 6 or 7),and heavier spiral sculpture. The specimen is, however, to fragmentary to serve as a type for a new variety or related species.

Gatun Siage; Coll. 7, Pumbri Creek, C. R.

Latirus irazu, n. sp. Plate 8, figure 12

Shell subfusiform; solid, with a long spire and shorter canal; whorls about 9, with heavy, sharp, knob-like ribs and finer spiral threads; the last whorl shows 7, sharp, pointed ribs, which are continuous from suture to suture, but only feebly across the base of the last whorl; the suture is bordered anteriorly by a prominent, frilled band or cord, formed by the elevated edges of the growth lines: spirals consisting of low, raised threads with wide interspaces; canal short, straight above but bent below, and with three small, smooth folds on the columella above; aperture with a thin outer lip.

Length 46, diameter 17, last whorl 29, spire 24 mm.

A smaller and more delicate species than the preceding *L. infundibulum* Gmelin. In the present shell, the ribs are sharper and more pointed, and the canal is shorter and more strongly reflected backwards. The strongly frilled sutural band is lacking or only imperfectly developed on *infundibulum*.

Gatun Stage: Port Limon.

Latirus taurus, n. sp. Plate 8, figure 4

Shell large, slender, solid with the spire more than ½ the height of the shell; whorls convex, with indistinct sutures; sculpture of very regular, narrow ribs with deep interspaces, and crossed by strong, ridge-like spiral cords; whorls about 9; axial sculpture on last whorl with about 11 ribs; the ribs commence well down on the base and continue to the upper suture and are nearly in line across the spire-whorls to the apex; the spirals consist of ridge-like cords and finer spiral threads; there are 2 principal spirals on the spire-whorls which cross the middle of the whorls; there are 4 principal spirals on the last whorl above the edge of the base, below which there are a few smaller threads; the anterior canal has 2 strong cords and finer threads are scattered over the whole shell; the anterior canal is straight and stocky and carries at its base a deep but narrow umbilical pit; the columella has 4 small folds; aperture subovate, anteriorly extended to form the long narrow canal; outer lip smooth within.

Height 60, diameter 25, aperture 32 mm.

A large, solid and strongly sculptured shell. The straight, narrow ribs are spaced regularly over the whorls of the shell and are continuous from the base to the upper suture. They are crossed by heavy, ridge-like, spiral cords, which on crossing the deep interspaces between the ribs, form small, sunken pits, so that the sculpture appears coarsely trellised.

Gatun Stage: Toro Cays.

Genus **PTYCHOSALPINX** Gill

Ptychosalpinx ? dentalis, n. sp. Plate 15, figures 14, 18

Shell buccinoid with convex, cancellated whorls; whorls about 6, with channelled sutures so that the whorls appear narrowly shouldered above; the sculpture is predominantly spiralled, the penultimate whorl with 7 strong spiral cords with interspaces 2 or 3 times their width; small spiral threads may appear in the interspaces; the last whorl has 14 or more spirals and the wide interspaces with one or more finer threads; the spirals are crossed by coarse wavy lines of growth, producing a sub-cancellate sculpture; the aperture is subovate; a well-developed siphonal sinus; the columella carries a single sharp plication at its lower end; the outer lip is slightly thickened and bears within about 12, small, narrow liræ.

Height 28, diameter 11, aperture 16 mm.

The generic relation of this interesting species is very much in doubt. It has the general form of *Cominella*, but its columella is provided with a strong anterior plication. In this regard it agrees with *Ptychosalpinx* of which there are several species in the Chesapeake Miocene. The apex of *dentalis*, appears to have been pointed and sharp, although all of our specimens have the tip of the spire very much weathered. True *Ptychosalpinx* is characterized by a large, convex and blunt nucleus and the outer lip is thin and smooth within. The outer lip of *dentalis* is slightly thickened and internally finely lirated.

The *P ? dentalis*, is a very characteristic fossil of the *Dentalium* zone of the Upper Uscari formation.

Uscari formation. *Coco Plum, Panama.*
Rio Cocles.
Comadre Creek, etc.

Genus **PERISTERNIA** Morch

Peristernia insula, n. sp. Plate 8, figure 11

Shell small, with a sharp pointed spire, a little longer than the aperture; the general form and sculpture of the shell is like that of *Urosalpinx cinereus* Say; nucleus of 2 small smooth whorls, followed by 7 post-nuclear; the profile of the spire-whorls is convex and strongly sculptured with ribs and sharp spiral cords; the last whorl has 8 ribs which are nearly lacking from the base of the whorl; the spiral sculpture consists of 2 principal cords about the middle of the earlier whorls above which lie smaller threads about the suture; on the later whorls, the spirals are somewhat heavier about the middle but irregular with finer, intermediate threads in between the principal ones; base contracted; aperture subcircular; outer and inner lips crenulated or denticulated; canal short and bent.

Height 23, diameter 13, aperture 11 mm.

This and the following *tortugera* seem correctly referable to the genus *Peristernia* Morch. The *P. insula* is somewhat like young specimens of *filicata* Conrad, from the Chesapeake Miocene of eastern United States, but has a longer and more pointed spire, and heavier sculpture.

Gatun Stage: Water Cay.

Peristernia tortugera, n. sp. Plate 8, figure 13

Shell elevated with a spire much longer than the aperture; nucleus of about 2½ small, smooth whorls; the post-nuclear whorls about 7; sutures distinct; whorls strongly convex, shouldered; sculpture of narrow, heavy ribs, widely spaced and numbering on the last whorl about 9; the rib are continued across the whorls from suture to suture and for a short distance down on the base; the spirals consists of irregular sharp cords; the early spire whorls carry 2 main spiral cords but bordered above and below by finer threads; the 2 principal spirals are continued on the later whorls but are nearly equalled in strength by the other spirals and hence lose their prominence; a short anterior canal; base strongly contracted.

Height 29, diameter 14.5, aperture 12 mm.

Distinguished from the preceding *insula* by its very much longer spire, more strongly contracted base and different spiral sculpture.

Gatun Stage: Port Limon.

Genus **XANCUS** Bolton

Xancus scopulus, n. sp. Plate 11, figure 1

Shell large, solid and heavy; spire nearly as long as the aperture; spire-whorls 6 plus (the tip broken), strongly coronate above and with large, wide, persistant ribs; the earlier spire-whorls are simply shouldered or angled about the middle, but the area about the upper sutures rapidly deepens and on the later whorls is a deep, excavated sutural zone, above which project the ends of the ribs; there is a strong sutural cord and a rather wide, ribbon-like band just above, forming at first a strongly appressed suture; the last whorl has about 7 large, wide ribs, the areas between appearing as troughs or depressions; the sutural excavated zone carries several irregular spiral threads which are crossed by large growth-lines so that the resulting sculpture is more or less cancellate, more particularily on the earlier whorls; the growth-lines cross the sutural cord and upon the ribbon above, become much crowded and strongly bent forwards; the young shell was sculptured over the whole shell with strong spirals, but with maturity, the spirals become obsolete and the shell is smooth and polished; columella with 3, strong plicæ as in the recent *scolymus*; a long anterior canal, with a narrow, deep umbilicus behind the spreading inner lip.

Height 265, diameter 136, aperture 158, last whorl 195 mm.

This very remarkable species is an extreme development of the *X. scolymus* stock in which the upper portion of the whorl becomes a wide, deep, excavated sutural zone. Above this excavated zone, project the high, rounded or appressed ribs and the carinate edge of the whorls. *X. scolymus* Gmelin, a recent specice found plentifully along the north Panama coast, has the whorls simply shouldered, often merely rounded.

The Santo Domingan Miocene contains *X. validus* Sowerby, which has been identified by some with *scolymus*. In *validus*, the ribs are more numerous (about 10) and are sharper and more tubercular in form.

Gatun Stage: Banana River.

Genus **MELONGENA** Schumacher

Melongena consors Sowerby Plate 9, figure 1

Pyrula consors Sowerby, 1849, Quart. Journ. Geol. Soc. London, vol. 6, p. 49.

Melongena melongena Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 205. Not of Linnæus.

Pyrula melongena Guppy, 1874, Geol. Mag., vol. 11, p. 438.

Pyrula melongena Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 32, p. 523.

Melongena consors Dall, 1900, Trans, Wagner Free Inst. Sci., vol. 3, pt 1, p. 121.

Melongena consors Maury, Bull. Amer. Pal., vol. 5, p. 249, pl. 14, fig. 5.

The *Melongena consors* is not a common fossil in Costa Rica. It is closely related to the recent *M. corona* Gmelin of the West Indies, the fossils shells differing mostly in having a longer spire and somewhat different sculpture above.

The Costa Rican examples are exactly like Miocene specimens from Santo Doingo. As a fossil it occurs in the Miocene of Jamaica, Santo Domingo and Venezuela.

Gatun Stage: Coll. 5, Old Man Sam Creek.
Cocles Creek.

Genus **SOLENOSTEIRA** Dall

Solenosteira Dalli, Brown and Pilsbry Plate 8, figure 8

Solenosteira dalli, Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 348, pl. 24, fig. 14.

Coralliophila gatunensis Toula, 1911, Jahrb. der K-K Geol. Reichsanstalt, vol. 61, p. 502, pl. 30, fig. 9.

A common species in the Canal Zone and figured here for comparision with the following species. The whorls are strongly shouldered, a feature accentuated by the few, but high,angled ribs. The spirals are heavy, raised cords, over and between which are finer secondary and tertiary threads.

Length 34, diameter 23, last whorl 27, spire 15 mm.

Gatun Stage: Gatun, Mt. Hope, C. Z.

Solenosteira Vaughani Dall, var. **medioamericana,** n. var. Plate 8, fig. 7

cf. *Solenosteira Vaughani* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1633, pl. 60, fig. 18.

Shell solid, with a small pointed nucleus of 2 smooth whorls, and 6 post-nuclear; spire conic, of about ½ the total length of the shell; whorls convex, or bluntly shouldered about the middle ; sculpture of numerous low ribs which are rounded, and heaviest on the shoulder angles; There are 7 to 10 ribs on the last whorl; spirals of raised cords, with finer threads on the interspaces; the spire-whorls have about 6 primary spirals, the last whorl with 18, including those of the short canal; canal short with a deep but narrow umbilical pit; aperture oval, a thick inner and outer lip, the outer with about 10, long, entering liræ and the inner with three small denticles above.

Length	diameter	last whorl	spire
42,	24,	34,	17 mm.
34	21.5	28	13 mm.

The *Solenosteira Vaughani* is a Chesapeake Miocene species from Jackson Bluff and Coe's Mill, Florida. Dall's figure in the Wagner Free Institute, is so like our shell from western Panama and Costa Rica, that there can be but little doubt of their close affinities.

The present shell is larger than the *S. Dalli*, of the Canal Zone, with more numerous, obtuse and not sharp ribs, and with a wider and deeper umbilical pit. A canal is developed at the posterior angle of the aperture as in the recent *S. pallida* Brod. while in *S. Dalli*, the posterior portion of the aperture is rounded and there is no canal.

Gatun Stage: Toro and Water Cay, Panama.
Hill 1a, Banana River, C. R.

Solenosteira chiriquiensis, n. sp. Plate 8, figure 3

Shell large, heavy; spire about ½ the height of the shell; whorls about 7, strongly angled about the middle and carrying heavy knob-like ribs, crossed by heavy spiral cords; the last whorl has 8 ribs which are developed only on the middle of the shell, being lacking from the upper slope and from the base of the last whorl; the tops of the ribs are crossed by 2 strong,spiral cords with a wide, trough-like interval between; above the 2 principal spiral cords, there are 4 smaller cords on the upper slope and on the base and canal 10 or 11; base of the last whorl contracted to form the straight canal which carries a deep, narrow umbilius; aperture subelliptical.

Height 57, diameter 34, aperture 34 mm.

It is possible that this species belong to the genus *Cymia* rather than *Solenosteira*, but its aperture is so completely filled with a hard sandstone matrix that the presence or absence of a columellar fold cannot be determined. Its sculpture however is more like *Solenosteira* than *Cymia*. The species will be recognized by its large size and characteristic sculpture.

Gatun Stage: Water Cay.

Genus **METULA** H. and A. Adams

Metula cancellata Gabb Plate 10, figure 12

Metula cancellata Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 205.

Metula cancellata Gabb, 1881, Journ. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 351.

Metula cancellata Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1584.

Metula cancellata Maury, 1917, Bull. Amer. Pal., vol. 5, 249, pl. 14, fig. 19.

Less common in Costa Rica and Panama than the following species and from which it is easily distinguished by its usual smaller size, more delicate shell, and fine sculpture.

The spiral threads on the last whorl number about 37 and are crossed by nearly as fine longitudinal ribs. The resulting reticulate sculpture is fine and neat. Our largest shell, a specimen from Bocas with 6 whorls measures:

Length 19, diameter 6.5, last whorl 14, spire 9, aperture 10 mm.

Gatun Stage: Bocas del Toro, Panama.
Hill 1a, Banana River, C. R.

Metula Gabbi Brown and Pilsbry Plate 10, figure 11

Metula Gabbi Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 351, pl. 25, figs. 4, 8.

This beautiful species is fairly common in the Canal Zone, but usually in a fragmentary condition. It related to the *Metula cancellata* Gabb, differing mainly in its larger size and heavier sculpture. On a speciman of 8 whorls from Gatun, the spirals on the spire whorl number about 8 and 39 on the last whorl and anterior canal. The 2 upper spirals are noticeably stronger than the others. Aperture long and narrow and finely denticulated along the interior of the outer lip.

The figured specimen from Gatun has the following measurements:

Length 29, diameter 10.5, last whorl 22, spire 12.5, aperture 16 mm.

Gatun Stage: Gatun and Mt. Hope, C. Z.

Metula Harrisi, n. sp. Plate 10, figure 10

Shell solid and more coarsely sculptured then *Metula Gabbi*, and with a longer and broaded spire and shorter aperture; whorl 6 plus, (apex lost); sculpture of spiral cords and finer, curved longitudinal ribs; the spire whorls with 8 spiral cords which are finest next to the lower suture, become progressively stronger above; on the last whorl and canal there are about 25 spirals; the spirals are slightly nodulated by the ribs of which there are about 40 on the last whorl; certain of the spirals on the middle of the whorl are double; aperture ovate-elliptical with a strongly thickened outer lip, internally with about 19 short liræ; inner lip smooth; canal short and twisted.

Length 26.5, diameter 11, last whorl 19.5, aperture 13.5, spire 14 mm.

A solid and more coarsely sculptured species than the *Metula Gabbi*. The spire is broad and porportionately longer, due to the shorter aperture. In *Gabbi* the spirals are of nearly equal strength over most of the shell surface with exception of those immediately bordering the upper suture. In the present species the spirals are finer below and progressively become stronger posteriorly.

The type specimen was collected in the lower Gatun sandstones of Coco Plum, Panana.

Gatun Stage: Coco Plum, Bocas del Toro, Panama.

Metula Harrisi var. **limonensis**, n. sp. Plate 10, figures 5, 6

Shell more slender; a narrow and longer aperture more nearly the length of the spire; sculpture coarsely reticulate, with 10 spirals on the penultimate whorl, about 26 on the last; aperture long, with a thickened outer lip, internally lirated in unison with the external spiral cords; inner lip smooth with a long, bent, beak-like canal.

Length 27, diameter 9.50, last whorl 19, aperture 14, spire 13 mm.

Several specimens from the coral limestones of Port Limon. They are most closely related to *Harrisi*, in their heavy shell, coarse sculpture, and thickened outer lip. They differ in being more slender, a longer aperture and in minor details of their sculpture.

Gatun Stage: Port Limon,

Genus **PHOS** Montford

Phos gatunensis Toula Plate 9, figures 4, 5

Phos gatunensis Toula, 1909, Jahrb. der K-K Geol. Reichsanstalt, Wein vol. 38, p. 701, pl. 28, fig 6; pl. 25, fig. 11.

Phos gatunensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila. vol. 63, p. 349, pl. 25, figs. 1, 2.

The *Phos gatunensis* is possibly the most common fossil in the Gatun beds of the Canal Zone and the adjacent sedimentary areas in the Province of Colon, but it still remains to be collected outside of this, its type area.

The shell is typically rather slender, with a sub-reticulate sculpture formed by the intersection of its numerous, straight longitudinal ribs, and the nearly equal, regular, strap-like, spiral cords.

A typical specimen measures as follows:

Length 30, diameter 13, last whorl 20, spire 15 mm.

Gatun Stage: Gatun, C. Z.

Phos mexicanus Bose Plate 9, figures 10, 11

Phos mexicanus Bose, 1906, Bol. de Inst. Geol. de Mexican, numero 22, p. 38, pl. 4, figs. 18-21.

Shell more broad and solid than *gatunensis* of the Canal Zone; whorls about 8, those of the spire with nearly straight or only slightly convex sides; last whorl large, broad, convex and widest about the middle; the sculpture is much more coarsely reticulate than in *gatunensis*, with the intersection points of the ribs and spirals more or less subnodulose; the last whorl has about 18 ribs, which on the back of the outer lip are more closely spaced than elsewhere; the spiral cords are not so heavy as the ribs, separated by wider interspaces which carry one or sometimes two very, fine, spiral threads; in addition, the spiral interspaces are very finely and neatly sculptured with fine, raised, longitudinal lines, corresponding to the growth-lines; on the spire-whorls there are 5 spiral cords, 13 on the last whorl and 3 more on the canal; canal short, twisted; aperture sub-elliptical, with a moderately heavy, but not thickened outer lip and internally lirated.

Length 30, diameter 15.5, last whorl 21, spire 14.5 mm.

A broader, more solid and more coarsely sculptured shell than the *Phos gatunensis* of the Canal Zone,

It was described from the Miocene of Paso Real, near Tuxtepec, in the State of Oaxaca, Mexico, by Dr. Bose, whose excellent figures agree exactly with specimens from Water Cay. The several species of *Phos*, are often extremely abundant but local in their distribution. Such is the case of *Phos gatunensis* of the Canal Zone, the *Phos Moorei* var. *costaricenis* of the Banana River. Likewise in the present instance; the *mexicanus*, is a very abundant fossil of the Gatun beds of the islands of the Chiriqui Lagoon and the adjacent Valiente Peninsula. A few specimens have also been collected in Costa Rica.

Gatun Stage: Water Cay. Toro Cay. Coco Plum, etc.
Rio Cocles, C. R.

Phos Moorei Guppy, var. **costaricensis**, n. var. Plate 9, figures 8, 9

Shell of medium size, solid; spire long about one-half the total length of the shell; whorls 10, of which the first two belong to a small smooth nucleus; succeeding whorls are sculptured with heavy persistent, straight ribs (13 or 14) on the last whorl; the ribs are crossed by even, raised, spiral cords; the spire-whorls have 4 spiral cords and a small one close to the upper suture; anterior canal short and strongly twisted; aperture subelliptical, the outer lip with about 10, strong and regular internal liræ.

Height 27, diameter 12, last whorl 17, spire 14 mm.

This is the common *Phos* of the Banana River. Although closely related to *Moorei*, from Jamaica, the Costa Rican fossils are smaller and more slender, as compared with Guppy's figure in the Quarterly Journal, vol. 22, pl. 16, fig. 11.

Dr. Maury's *Phos Moorei*, from the Miocene of Santo Domingo probably represents a distinct species, differing by its more slender spire, and in sculpture. The spiral intervals of *costaricensis* are smooth, while in the Santo Domingan shells, they carry fine spiral threads, which are best seen on the spire-whorls, sometimes becoming obsolete on the later.

Gatun Stage: Banana River,
Old Man Sam Creek, 1 mile from shore or beach.

Phos elegans Gupp, var. **limonensis**, n. var. Plate 9, figures 12, 13

Shell usually smaller, more slender and delicate than the preceding species; the spire is long, composed of about 9 whorls: the nucleus consists of 4 whorls, the first 2 are small, smooth and convex, the last 2, smooth, but sharply keeled about the periphery on the last 1-4 of the last nuclear whorl, faint curved lines appear above the peripheral keel, they gradually increase in strength and on the 1st post-nuclear whorl become the longitudinal ribs; the sculpture consists of fine, longitudinal ribs (23 or 24 on the last whorl); occasionally a rib may become greatly enlarged, forming varix-like thickenings corresponding to resting stages; the ribs are overrun by primary, secondary and tertiary spiral threads; the later spire whorls have about 6 spirals, with about 17 on the last whorl and the canal; aperture suboval, with a heavy but not thickened outer lip, internally lirated.

Length 27, diameter 11, last whorl 17, spire 4.5 mm.

This shell is related to the *Phos elegans* Guppy of the Miocene of Jamaica and Santo Domingo. Our shells differ from typical examples of *elegans* from Santo Domingo, in being larger, and more coarsely sculptured.

Varix-like thickenings occur scattered along the spire-whorls. The protoconch of typical *elegans* and *limonensis* are practically identical. The recent West Coast *Phos Veraquensis* Hinds is a related but more finely sculptured species.

Gatun Stage: Port Limon.
Bocas del Toro.

Phos estrellensis, n. sp. Plate 9, figures 17, 18

Shell small, slender, solid; spire much longer than the aperture, pointed; whorls of the spire 6 or more, convex in profile with deep sutures; sculpture of narrow, straight ribs which commence on the columellar area and pass across the whorl to the upper suture; there are 12 or 13 ribs on the last whorl which are evenly and widely spaced except on the back of the outer lip where they are smaller and more numerous; the spirals consist of a primary set of threads or cords with a single, smaller secondary thread in each interspace except on the base and the canal; the primary threads crossing the ribs form small, whitish tubercles; the spire-whorls have 4 primary spirals and there are 11 on the last whorl, exclusively of the canal; aperture sub-elliptical, produced anteriorly to form the straight anterior canal; outer lip thickened and internally lirated.

Height 20, diameter 8, aperture 9 mm.

A small, slender species, coarsely sculptured like the larger and broader *Phos Moorei* variety *costaricensis.* It is limited in our collections to the Gatun beds of the Estrella River.

Gatnu Stage: Coll. 6, 7, Estrella River.

Phos subsemicostatus Brown and Pilsbry Plate 9, figure 15

Phos subsemicostatus Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 350, pl. 25, fig. 3.

A larger and finer sculptured species than the Dominican *Phos semicostatus* of Gabb. A single imperfect specimen was collected from Zone E of Saury Creek.

Gatun Stage: Gatun (Brown and Pilsbry)
Zone E, Saury Creek, C. R.

Phos Veatchi, n. sp. Plate 9, figures 2, 3

Shell large and heavy, with a moderately long, coarse spire of about 9 whorls; nucleus small, of 2 smooth whorls; whorls of the spire moderately convex, with strong ribs continuous from suture to suture; sutures appressed and bordered below by a small spiral; the last whorl is widest about the middle and contracted below to the short anterior canal; sculpture of heavy, persistent ribs and regular raised spirals; the last whorl has 8 ribs; the spirals consists of raised threads, separated by wide, interspaces; an occasional secondary spiral will appear in the interspace but they are generally smooth or only obsoletely sculptured by the growth lines; there are 8 spirals on the spire-whorls, 16 or 17 on the last whorl; aperture ovate, with the outer lip thickened by the last rib, and internally with 9, long, entering liræ; inner lip formed by a raised, spreading callus, armed above by a tooth-like denticle and a strong fold below on the edge of the canal.

Length 43, diameter 22, last whorl 28, spire 25 mm.

A large, robust species from Hill 1a of the Banana River. It differs from the *subsemicostata* by its strong persistent ribs and coarser spirals.

It is named for Dr. A. C. Veatch, Director of the Exploration work of the Sinclair Oil Corporation, under whose direction the Costa Rican collections were made.

Gatun Stage: Hill 1a Banana River.

Phos beteyensis, n. sp. Plate 9, figure 6

Shell of the type of *subsemicostata*; whorls 3, moderately convex; sculpture with the axial element very weak but present on the penultimate whorl as fine, sub-obsolete, narrow ribs or irregular wrinkles on the shell surface; they are absent from the last whorl; the spiral sculpture consists of a broad zone, about the upper 1-3 of the spire whorl on which are irregularly distributed about 5 raised spiral threads; below this zone, the sculpture is largely in the form of broad uneven bands formed between incised spiral lines; on the last last whorl, this later zone occuppies the middle of the whorl; the zone of raised spirals above the more smooth area of banded spirals gives to the whorls a slightly coronated appearance.

Length 27 (2½ whorls), diameter 15, last whorl 21 mm.

The type specimen is very incomplete, but its characters are so distinctive and unlike any other species of *Phos* which we have seen that its discription is advisable. Like the *subsemicostatus* the longitudinal ribs or costæ fade out on the later whorls.

Gatun Stage; Betey Creek, C. R.

Phos metuloides Dall Plate 9, figure 16

Phos metuloides Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 310, pl. 28, fig. 15.

Phos metuloides Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 350.

Phos metuloides Maury, 1917, Bull. Amer. Pal., vol. 5, p. 252, pl. 14, fig. 17.

A small species with a neat sculpture recalling that of *Metula cancellata* and *gabbi*. It is not rare in the Gatun beds of Mt. Hope in the Canal Zone. Dall also records it from the Miocene of Santo Domingo.

Length 19, diameter 9, spire whorl 13.5, spire 10 mm.

Gatun Stage: Mt. Hope.

Genus ALECTRION Montfort

Alectrion ranuncula, n. sp. Plate 9, figures 20, 22

Shell of medium size, with a large body-whorl and a sharp pointed spire; the general form and sculpture recalls the recent *A. acuta* Say; spire about the same length as the aperture and canal and composed of about 7 whorls, of which the first 2 belong to the small, smooth nucleus; the profile of the spire-whorls is convex with deep, excavated sutures; sculpture of narrow ribs, the tops of which are crossed by spirals and separated by wide, smooth interspaces; the last whorl has about 9 ribs which are large and humped on the ventral face, finer and more numerous on the back; there are 3 spirals on the spire-whorls and 7 on the last with several more on the short canal; aperture subcircular with a large, heavy outer lip, internally denticulated.

The general form and sculpturing recalls the recent East Coast *Alectrion acuta* Say, but the Costa Rican shell is much broader as indicated by the following comparative measurements with *A. acuta* Say, of the same height.

Height 14.00, diameter 6.25, last whorl 8, aperture 6 mm.
(*Alectrion acuta* Say)

Height 14.50, diameter 8.25, last whorl 9, aperture 7.5 mm.
(*Alectrion ranuncula*, n. sp.)

It is not uncommon in the Gatun beds of the Banana River.

Gatun Stage: Hill 1a, Banana River.
Coll. 7 Estrella.

Alectrion losquemadica Maury Plate 9, figure 21

Alectrion losquemadica Maury, 1917, Bull. Amer. Pal., vol. 5, p. 255, pl. 15, figs. 22, 23.

The Costa Rica fossil is similiar in its sculpturing and form to the common recent West Indian *A. ambigua* Montfort. As Maury has pointed out in regard to the Dominican examples, the difference between *losquemadica* and *ambigua*, lies in the protoconch, which in typical *ambigua* is short and blunt, but pointed and composed of several whorls in *losquemadica*. Our shells are larger than typical *losquemadica* from Santo Domingo.

Height 11.50, diameter 7.00 mm.

Gatun Stage: Port Limon.
Coll. 7, Estrella River.

Alectrion merenda, n. sp. Plate 9, figure 19

Shell small, a large body whorl and a sharp pointed spire; nucleus of 2 small, convex whorls followed by 5 post-nuclear whorls; sutures distinct but not excavated; the sculpture consists of about 12 ribs which are variable in their strength and spacing; the ribs are crossed by subequal spiral cords separated by wide, interspaces in which there may appear a smaller intermediate spiral; the suture is bordered by a set of 2 or 3 finer spirals; there are 3 spirals on the spire-whorls and 8 on the last whorl above the contracted zone of the canal; aperture subcircular with a thick, heavy outer lip.

Height 7, diameter 4.5 mm.

The aperture is completely filled with a hard matrix which completely conceals the characters of the inner and outer lips.

Uscari Stage: Old Man Sam Creek.

Genus **NORTHIA** Gray

Northia northiae Gray, var. **miocenica**, n. var. Plate 9, figures 7, 14

cf. *Northia northiæ* Gray, 1834, in Griffith's Cuvier, pl. 30, fig. 2.

cf. *Northia northiæ* Kiener, 1832 Icon., *Buccinum*, p. 23, pl. 9, fig. 28.

The *Northia northiæ* Gray, (*N. serrata* Dufresne) is a common and characteristic West Coast or Pacific species, ranging from the Bay of Panana to Guayaquil Ecuador. The fossils represented by three incomplete specimens differ only from recent examples from Panama in lacking the hump-like thickening in back of the outer lip and the corresponding shoulder to its whorls. But this is not an importnnt character and recent examples may sometimes lack this character.

But few investigators who have studied the West Iadian Miocene have failed to note the large percentage of species, closely related or even identical with recent Pacific species, a condition indicative of the union of the Atlantic and Pacific, permitting a free intermingling of their respective faunas. Late during the Miocene, this union was brought to a close or largely restricted, and since then the Pacific element has gradually given way before the encroachment and development of the West Indian. That this extinction has been a gradual one is shown by the Pleistocene deposits of Panama containg several common West Coast species not known from the recent Caribbean. Such species are the *Pecten ventricosus* Sowerby and *Northia northiæ* both recorded by Dall from the Pleistocene of Panama or Costa Rica.

Gatun Stage: Middle Creek.
Banana River, Hill No. 3.
Coll. 6, Red Cliff Creek.

Genus **COLUMBELLA** Lamarck

Columbella submercatoria, n. sp. Plate 10, figures 33, 34

Shell ovate, solid, a small conic spire and a large body-whorl; whorls about 7; spire-whorls but slightly convex so that the profile of the spire is nearly plane; last whorl large, broadly convex about the upper 1-3 and sloping evenly below to the short, produced anterior canal; sculpture of subobsolete spirals, there being about 6 on the spire-whorls and about 22 on the last whorl; aperture linear with a thickened outer lip, expanded in the middle and finely and evenly crenulated throughout; anterior canal short and armed with 8 strong denticles.

Length 17, diameter 10.5, aperture 11, spire 5.5 mm.

Closely related to the recent *C. mercatoria* Linn., common along the northern Costa Rican coast, but differs in its more globose form and finer spiral sculpturing. Traces of coloration are still preserved as faint blotches of yellow scattered over the back of the shell.

Typical *Columbella* has heretofore not been recorded from beds older then the Pliocene either in America or Europe.

Gatun Stage: Zone 5, Red Cliff Creek.

Genus **STROMBINA** Moerch

Strombina ambigua Guppy Plate 10, figure 9

Columbella ambigua Guppy, 1866, Quart. Jour.Geol. Soc. London, vol. 22, p. 288, pl. 16, fig 8.

Strombina ambigua Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1584.

This species was described from the Bowden beds of Jamaica, of Miocene age. Our shells from Costa Rica agree exactly with Guppy's figure in the Quarterly Journal.

A large species of Columbelloid aspect due in large measure to the slight thickening of its outer lip. The sculpture consists of about 25 ribs, which are smooth on the spire whorls and upper half of the last. The base of the last whorl and the canal have in addition about 14 spiral cords.

Length 27 (7 plus whorls), diameter 10, spire 15, aperture 13 mm.

Gatun Stage: Banana River.

Strombina Lessepiana Brown and Pilsbry Plate 10, figures 13, 20

Strombina lessepiana Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 352, pl. 25, figs. 11, 12.

Columbella (*Strombina*) *gatunensis* Toula, 1911, Jahrb. der K-K, Geol. Reichsanstalt, Wien, vol. 61, p. 501, pl. 30, fig. 8.

An abundant species in the Canal Zone and with the exception of *S. ambigua*, the largest species of *Strombina* in the Miocene beds of Panama and Costa Rica. The spire is long and smooth, with the exception that the upper sutural zone is usually distantly raised into small, longitudinal plicæ which is most characteristic. An average specimen from the Canal Zone will measure:

Length 25, diameter 10, spire 13, aperture 12.50 mm.

We collected from the lower Gatun sandstones of Cocles Creek, near Old Harbor, Costa Rica, several small Strombinas which except for size are typical *Lessepiana*.

Gatun Stage: Gatun and Mt. Hope, C. Z.
Cocles Creek, C. R.

Strombina matima, n. sp. Plate 10, figure 7

Shell ovate, moderately solid with a long evenly tapering and sharp-pointed spire; nucleus small, pointed and of three, smooth whorls; post-nuclear whorls 6; suture distinct and bordered anteriorly by a small sutural ridge; the sculpture consists of about 18, smooth, narrow ribs, which are lacking from the back of the last whorl, which is smooth; the ribs are oblique in direction and along the upper sutures are slightly knobbed by the sutural ridge; the base of the last whorl and canal carries about 12 spirals; aperture subelliptical with a heavy outer lip internally provided with 3 or 4 denticles about the middle; anterior canal straight and smooth within.

Height 12, diameter 5.25, aperture 6 mm.

This is a species with a long, evenly-tapering spire and small nucleus. The spire-whorls are sculptured with numerous, small, smooth riblets. The riblets are obsolete on the back of the last whorl which is entirely smooth except for the spirals about the base and canal. *S. matima* resembles *S. Bassi* Maury, from the Miocene of Santo Domingo but is more slender and has a great many more ribs.

Gatun Stage: Hill 1a, Banana River.
Coll. 7, Estrella River.

Strombina cricamola, n. sp. Plate 10, figure 18

Shell ovate, solid, with a large, convex and spirally sculptured body-whorl and a long attenuated spire; whorls 6 plus (apex broken so that at least one complete whorl is lost from the type specimen); the first 4 whorls are smooth, after which a few incised spiral lines appear just below the upper suture; these spirals gradually increase in strength and in number and on the following whorls have become strong, raised spiral cords; the penultimate whorl has 5 spirals, the last about 24 (including those of the anterior canal); the upper half of the last whorl and sometimes the penultimate, are longitudinally plicated with 18 rib-like costæ; aperture narrow, with a thickened outer lip, notched above and obsoletely denticulated below; the inner lip is smooth; canal short, twisted.

Length 16, diameter 8.5, aperture 9, spire 7 mm.

An unusually short and broad species, distantly related to the *C. pulcherrima* Sowerby, recent from the Gulf of Dulce. Two specimens were collected from the Gatun sandstones of Water Cay.

Gatun Stage: Water Cay.

Strombina costaricensis, n. sp. Plate 10, figures 8, 17

Shell solid, ovate, with a long attenuated spire; last whorl, large, flattened or contracted about the middle; whorls about 9½; the first 6 whorls are smooth and form the long attenuated spire; faint longitudinal plicæ appear on the 7th, which increase in size and form the rib-like costæ on the later whorls; axial ribs persistent and number on the last whorl about 15; the spirals begin shortly after the first appearance of the longitudinal plicæ as faint incised lines near the upper suture; these spiral lines are further increased by the introduction of more lines below and become on the following whorls raised spiral cords; the penultimate whorl has 5 or 6 spirals, the last with about 20; the spirals vary in strength on individual shells and on some specimens may be lacking from the middle of the whorl, forming a smooth median band; aperture linear, small and coutracted and with a caloused inner and outer lip; outer lip strongly thickened, notched above and feebly dunticulated below; canal short, straight.

Length 15.5, diameter 7.5, spire 8, aperture 8 mm.

A species with an *Anachis*-like sculpture, the ribs and generally the spirals being persistent. The body-whorl is flattened or slightly contracted about the middle, but less so than in the following variety. A long, tapering and nearly smooth spire as in the preceding *S. cricamola* but much more slender and attenuated.

Gatun Stage: Headwater of Middle Creek, C. R.

Strombina costaricensis, var. **musanica**, n. var. Plate 10, figures 26, 27

Shell ovate, with a long, conic spire of 8 or more whorls; last whorl strongly contracted or indented about the middle; the first 3 whorls or more (apex broken) are smooth or sculpturless; on the following 3 whorls, the sculpture is largely of numerous, straight rib-like costæ, the spirals being only very faint and indistinct; on the last whorl the ribs number about 14; spirals about 9 on the penultimate whorl as faint raised threads and on the last whorl may be lacking from the middle or contracted zone; aperture linear-ovate, a thickened outer lip with 3 faint denticles below the upper notch; canal straight.

Length 15, diameter 6.5, spire 13, aperture 8 mm.

Probably a distinct species from the preceding and differing in its more evenly tapering and more strongly sculptured spire, and deeply contracted body-whorl. It resembles somewhat the figure of *S. cartagensis* Brown and Pilsbry from Colombia, but is smaller and has more numerous ribs. The periphery of *S. cartagensis* is rounded.

Gatun Stage: Banana River, C. R.
East fork of Red Cliff Creek.

Strombina sincola, n. sp. Plate 10, figures 19, 21

Shell small, with a large, conic spire and a dorso-ventrally flattened body-whorl; whorls about 8, the first 3 belonging to the small, smooth, pointed nucleus; sculpture of the post-nuclear whorls of numerous, straight, strong, longitudinal ribs, which are persistent to the penultimate whorl, but are laking from the last whorl which is smooth and polished; the penultimate whorl has about 15 ribs; the ribs are generally beaded about their upper extremities; sutures distinct; last whorl large and strongly laterally flattened between a prominent ridge or hump on the left-hand side of the whorl and the large outer lip; aperture subelliptical with a large, expanded outer lip, deeply indented behind; canal short and beak-like and spirally striated with about 8 threads on the back.

Length 7, diameter 3.25, spire 3.50, aperture 3.75 mm.

A small species abundant in the Gatun beds of Hill 1a, of the Banana River. The last whorl is rather small and strongly flattened dorso-ventrally. The spire is large and about ½ of the total length of the shell.

Gatun Stage: Hill 1a Banana River.
Hill 3, Banana River.

Strombina chiriquiensis, n. sp. Plate 10, figures 14, 24

Shell small and in genral characters like the preceding but with a larger body-whorl and a shorter, more conic spire; whorls about 8, of which the first 3 are smooth and belong to the small pointed nucleus; the succeeding whorls until the penultimate are sculptured with fine, straight, longitudinal ribs, there being 19 on the penultimate whorl; the last whorl is rather large, smooth and dorso-ventrally flattened between a hump-like ridge on the left side and the large, expanded outer lip; canal short, beak-like and spirally striated; aperture linear-ovate, deeply indented behind; inner and outer lips are both heavily calloused, especially about their posterior portions; over this callous and between the outer and inner lips passes the small posteriorly directed canal; lower half of the inner and outer lips denticulated with 8 or 9 strong, denticles, heaviest above.

Length 7.50, diameter 4.25, spire 2.50, aperture 4.50 mm.

Of much the same size and general characters as *S. sincola* of

Costa Rica, but with a larger and broader body-whorl, and a shorter, more conic spire. The porterior portion of the inner and outer lips are heavily calloused, a feature not developed in *S. sincola*.

Gatun Stage: Water Cay.

Genus **MUREX** Linnæus

Murex messorius Sowerby

Murex messorius Sowerby, 1840, Proc. Zool. Soc. London, p. 137.

Murex recurvirostris Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 201. Not *M. recurvirostris* Broderip.

Murex messorius Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila. vol. 63, p. 353.

Murex messorius Maury, 1917, Bull. Amer. Pal., vol. 5, p. 265, pl. 16, figs. 1, 2.

This is the common *Murex* in Costa Rica. It is generally small, seldom exceeding 40 mm in height. Each whorl carries three primary varices, between which are 3 or 4 smaller ribs or costæ. It is a recent species in the West Indies.

Gatun Stage: Gatun, C. Z.
Water Cay, Panama.
Zone 5, Red Cliff Creek.
Coll. 7, Pumbri Creek.
Banana River.

Subgenus **PHYLLONOTUS** Swainson

Murex cornurectus Guppy

Murex (*Chicoreus*) *megacerus* Gabb, 1873, Trans. Amer, Phil. Soc., vol. 15, p. 202. Not *M. megacerus* Sowerby.

Murex cornurectus Guppy, 1876, Quart. Journ. Soc. London, vol. 32, p. 521, pl. 28, fig. 4.

Murex (*Phyllonotus*) *cornurectus* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 267, pl. 16, figs. 9, 10.

A large species, possibly identical with the recent *Murex brevifrons* Lamarck. The varices are large and cross the spire whorls in a spiral direction. Between the varices, there is generally a single rib-like elevation in the middle of the whorl.

Gatun Stage: Coll. 4, East Grape Point Creek.
Coll. 5, Bed Cliff Creek.
Rio Betey.
Sousi Creek.

Genus **TYPHIS** Montfort

Typhis alatus Sowerby Plate 10, figure 15

Typhis alatus Sowerby, 1849, Quart. Journ. Geol. Soc. London, vol. 6, p. 48, pl. 10, fig. 4.

Typhis alatus Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 203.

Typhis alatus Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 32, p. 522.

Typhis alatus Brown and Pilsbry, 1911, Proc. Acad. Nas. Sci. Phila., vol. 63, p. 354.

A very characteristic species distinguished by the large wing-like expansion of its outer lip. It is the largest species in the Gatun and measures about 23 mm in height by 17 mm in diameter. It is found also in the Miocene of Santo Domingo and in the Bowden beds of Jamaica.

Gatun Stage: Gatun, C. Z. (Brown and Pilsbry)
Toro Cays, Panama.

Typhis linguliferus Dall, var. **costaricensis**, n. var. Plate 10, figs 22, 29

cf. *Typhis linguliferus* Dall, 1890, Trans. Wagner Free Inst. Sci., vol. 3, pt. 1, p, 152, pl. 12, fig. 7.

This is a smaller and more delicate species than the *T. Gabbi* Brown and Pilsbry from the Canal Zone. They agree with the Chipolan *linguliferus* Dall in their general form but differ in their uniformly smaller size and in nearly lacking the spine-like process on the shoulder of primary varices. It is fairly abundant in the Gatun beds of the Banana River.

Gatun Stage; Hill 1a, Banana River.

Genus **SISTRUM** Montfort

Sistrum nodulosum C. B. Adams Plate 10, figure 23

Purpura nodulosa C. B. Adams, 1845 Proc. Bost. Soc. Nat. History, p. 3.

Ricinula nodulosa Tryon, 1880, Manual of Conch., vol. 2, p. 190, pl. 59, fig. 275.

Sistrum nodulosum Dall and Simpson, 1901, Bull. U. S. Fish. Com., vol. 1, p. 411.

Worn specimens of the species occur in the transitional beds of Red Cliff Creek. They cannot be separated from recent examples from the present coast. It is very common as a recent species on the rocks and reefs along the northern Costa Rican and Panama coast, where it occurs about high-water level, associated with the equally as abundant *Engina turbinella* Kiener and *Phasianella affinis* C. B. Adams.

Uscari and Gatun transitional beds; Zone 5 and 6, Red Cliff Creek.

(*C*) *SUPER-FAMILY TÆNIOGLOSSA*

Genus **DISTORTRIX** Link

Distortrix simillima Sowerby

Triton simillimus Sowerby, 1849, Quart. Journ. Geol. Soc. London, vol. 6, p. 48.

Persona simillima Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p. 288, pl. 17, fig. 13.

Distortia simillimus Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 212.

Persona simillima Guppy, 1874, Geol. Mag., p. 439.

Persona simillima Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 35, p. 522.

Distorsio (*Distortrix*, *Persona*) *gatunensis* Toula, 1908, Jahrb. der K-K Geol. Reichsanstalt, Wien, vol, 58, p. 700, pl. 25, fig. 10.

Distorsio gatunensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phil., vol. 63, p. 356, pl. 29, fig. 8.

Distortrix simillima Maury, 1917, Bull. Amer. Pal., vol. 5, p. 271, pl. 17, figs. 4, 5.

Not common in Costa Rica. It also occurs in the Miocene of Jamaica and Santo Domingo.

Gatun Stage; Gatun, C. Z.
Banana River.
Port Limon.

Genus **BURSA** Bolten

Bursa crassa Dillwyn Plate 15, figure 15

Ranella crassa Dillwyn, Reeve, Conch. Icon.,fig. 18.

Ranella crassa Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p. 288, pl. 18, fig. 9.

Bursa crassa Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 212.

Ranella crassa Guppy, 1874, Geol. Mag., p. 438.

Ranella crassa Guppy, 1876, Quart. Jouru. Geol. Soc. London, vol. 32, p. 522.

Bursa crassa Maury, 1917, Bull. Amer. Pal., vol. 5, p. 272, pl. 17 figs. 6, 7.

This is a recent species in the West Indies. It occurs also as a Miocene fossil in Jamaica and Santo Domingo.

Gatun Stage: Banana River.
Saury Creek.

Genus **CASSIS** Lamarck

Cassis sulcifera Sowerby

Cassis sulcifera Sowerby, 1849, Quart. Journ. Geo l. Soc. London, vol 6. p. 47, pl. 10, fig. 1

Cassis sulcifera Maury, 1917, Bull. Amer. Pal., vol. 5, p. 274, pl. 18, figs. 1, 2. 3.

This is a large species very common in Miocene rocks of Santo Domingo but very rare in Costa Rica. Our record is based on a single imperfect specimen from the Banana River and for a figure of this species the reader is referred to Dr. Maury's Dominican Fossils.

Gatun Stage: Hill No. 3, Banana River.

Cassis flammea Linnæus

Buccinum flammeum Linnæus, 1758, Syst. Nat., ed. 10, p. 736.

Cassis flammea Reeve, 1848, Conch. Icon., vol. 5, pl. 5, fig. 12.

Cassis flammea Gabb, 1881, Journ. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 356.

This is a recent species recorded by Gabb, from his so-called Pliocene clay beds of Costa Rica. Under this term, Gabb confused two formations, one composed largely of coralline limestones but with subordinate amounts of clays and sands equivalent in large measure to the Gatun formations,and an overlying, mostly sand and clays of true Pliocene age. It is most likely that the single example of *Cassis flammea* collected by Gabb, was obtained from the upper or Pliocene formation.

Subgenus **PHALIUM** Link

Phalium moniliferum Guppy Plate 12, figure 11

Cassis monilifera Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p. 287, pl. 17, fig. 8.

Casidea granulosa Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 222. Not *C. granulosa* Bruguiere.

Cassis reclusa Guppy, 1874, Geol. Mag., London. pp. 434, 439.

Cassis reclusa Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 32, p. 525.

Cassis monilijera Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 32, p. 525.

Phalium moniliferum Maury, 1917, Bull. Amer. Pal.. vol. 5, p. 274, pl. 18, figs. 4, 5; pl. 19, fig. 1.

The Costa Rican specimens like those of Santo Domingo are extremely variable in their sculpture. The typical *moniliferum* of Jamaica carries on the shoulder of the body-whorl one or two rows of large tubercles or granules and Guppy's figure shows the spirals below as finely granulated.

In Costa Rica, the shells may vary from those with nearly smooth spirals, through transitional forms in which only the superior bands are granulated, to the extreme in which all the spirals are finely granulated over the whorl shell. A typical specimen will average:

Length 35, diameter 22 mm.

Gatun Stage: Middle Creek.
Rio Betey.
Zone 5, Red Cliff Creek.

Genus **SCONSIA** Gray

Sconsia laevigata Sowerby, var. **Gabbi,** n. var. Plate 12, figure 3

cf *Cassidaria laevigata* Sowerby, 1849, Quart. Journ. Geol. Soc. London, vol. 6, p. 47, pl. 10, fig. 2.

cf *Cassidaria sublaevigata* Guppy, 1866, *Idem*, vol, 22, p. 287, pl. 27, fig. 9.

Cassidaria laevigata Gabb, 1881, Journ. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 356.

cf *Sconsia sublaevigata* Bose, 1906, Bol. Inst. Geol. de Mexico, Numero 22, p. 36, pl. 4, figs. 9, 10.

Sconsia laevigata Prown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila. vol. 63, p. 356.

cf *Sconsia laevigata* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 275, pl. 19, fig. 2.

As Gabb noted years ago, the Sconsias of Costa Rica are not the typcal *laevigata* of Santo Domingo but appear to approach more closely in their striated whorls, the Jameican *sublaevigata* of Guppy and the recent *striata* of Lamarck.

Typical *laevigata*, has generally a distinct shoulder to its body-whorl and a lower spire. The spire-whorls are striated but the spirals are lacking from the generally polished body-whorl. The aperture of *laevigata* is subrectangular in outline, rather wide anteriorly and flaring posteriorly, while in *Gabbi*, the aperture is narrow and but little larger anteriorly. In *laevigata*, the callus of the inner lip is large and spreads widely over the columellar area, but its outer edge is raised and shelf-like, instead of rounded and appressed as in *Gabbi*. Mature shells of *laevigata*, have three large, heavy varices, marking the resting stages but such varices are small and sometimes entirely lacking from the Costa Rican shells.

Typical *laevigata* will probably be found to be largely limited to Santo Domingo. The Jamaica *sublaevigata* (possibly a variety) has more strongly sculptured whorls, a short spire and less complete varices. Its aperture is that of true *laevigata*.

The *Sconsia laevigata* was found by Dr. Maury, in her work on the Paleontology and Stratigraphy of Santo Domingo to be limited to her upper or Gurabo formation (the-*Sconsia laevigata* zone). In Panama and Costa Rica, the *Sconsia laevigata* variety *Gabbi*, is frequently very abundant in the Gatun beds, but it is apperently lacking from the underlying Uscari shales where it is replaced by the new *Sconsia cocleana* and probably *bocasensis*.

Gatun Stage: Gatun, C. Z.
Toro Cay, Water Cay, Panama.
Comadre Creek near Cahuita C. R.
Rio Blanco, C. R.

Sconsia bocasensis, n. sp. Plate 12, figures 12, 13

Shell like that of *laevigata*, but narrow and with coarsely sculptured whorls; spire more evenly conic, the apex of which is not produced or attenuated; whorls coarsely sculptured with heavy, persistent spirals threads, of which there are about 9 on the spire-whorls and nearly 50 on the last whorl; sutures appressed and bordered anteriorly by a strong ridge-like cord or by stronger spirals; the varices are but slightly developed; aperture subelliptical, widest about the anterior 1-3; outer lip thickened and with about 18, fine, liræ-like denticles ; the inner lip with a thin spreding callus and with about 16 long, narrow rugations.

Length 35 (last 2 whorls only) diameter 25 mm.

Differs from the variety *Gabbi* of *laevigata* by its more narrow shell, coarser sculpture and larger aperture. The suture is bordered by a cord-like ridge.

Gatun Stage: Bocas del Toro.

Sconsia cocleana, n. sp. Plate 12, figure 7

Shell globose; spire low of about 7 whorls, the apex slightly projecting; sutures distinct and deep, but not appressed; surface coarsely sculptured with large, irregular, but narrow spirals bands separated by deep interspaces which may in addition carry one or more finer spiral threads; there are 7 or 8 spirals on each spire whorl; on the last whorl the spirals are nearly twice as wide as the upper third of the whorl and more anteriorly; no varices; the outer lip is broken from the single specimen; inner lip is a wide but thin wash of callus, without rugations or denticles of any sort.

Length 46, diameter 32 mm.

The Uscari shales which everywhere in Costa Rica appear to underlie the Gatun sandstones is very rich in the smaller types of foraminifera, but mollusks are rare, fragmentary and difficult to collect. Fragments of *Sconsia*, were noted by us at several places which we believe belong to this species or to the *bocasensis.*

This species will be recognized by its broad, globose shell and small spire. It lacks the sutural cord so strikingly developed on *bocasensis.*

Uscari Stage: Rio Cocles near Old Harbor, C. R.

Genus **DOLIUM** Lamarck

Subgenus **MALEA** Valenciennes

Malea elliptica Pilsbry and Johnson Plate 12, figure 2

Malea elliptica Pilsbry and Johnson, 1917, Proc. Acad, Nat. Sci. Phila., vol. 69, p. 169.

The true *Malea camura* Guppy, so common in the Miocene of Jamaica and Santo Domingo still remains to be collected in Costa Rica. It is usually a smaller species (height 60 mm) with a heavier shell and high, narrow, special bands numbering about 16 or 17 rather widely separated.

The *M. elliptica* is larger (height 60-80 mm or more), more globose and thin. The spiral bands numbering about 22 are closely spaced and ribbon-like. The coiling is regular, while in *camura* the coiling is irregular and descending in the latter stages of growth.

The *Malea elliptica* was described but not figured by Johnson and Pilsbry from the Miocene of Santo Domingo.

Height 63, diameter 54 mm.

Uscari Stage: Red Cliff Creek.

Gatun Stage: Bocas del Toro. Estrella River.
Hill 1a, Banana River.

Genus **CYPRAEA** Linné

Cypraea parisimina, n. sp. Plate 12, figure 10

Shell small, more or less depressed and with expanded, angulated sides; dorsal surface convex, but with a deep pit or depression at its posterior end, beyond which project the 2 short, pouting ends of the lips of the aperture; ventral surface flat, with a narrow aperture which is straight except near at its posterior end where it is slightly curved; lips strongly but regularly crenulated (about 21 on each lip) posterior sinus small and curved to the left; anterior sinus small and rounded.

Length 39, basal diameter 25, height or vertical diameter 17 mm.

A small shell with strongly depessed and angulated sides. Collected from the coral limestones of Port Limon.

Gatun Stage: Port Limon,

Cpyraea cf. **dominicensis** Gabb

Cypraea Dominicensis Gabb, 1873, Amer. Phil. Soc., vol. 15, p. 236.

Cypraea dominicensis Maury, 1917, Bull. Amer. Pal., vol. 5, p. 280, pl. 19, fig. 11

Our collection contains a single, fragmentary shell from the coralline limestones near Limon. This specimen agrees closely with the Dominican shell figured by Dr. Maury as *C. dominicensis ?*. It is characterized by its very thin shell, cylindroid form and straight, evenly denticulated apertrue.

Length 28, height 12 mm.

Gatun Stage: Port Limon.

Cypraea cinerea Gmelin Plate 12, figure 8

Cypraea cinerea Gmelin, 1792, Syst. Nat., p. 3404.

Cypraea cinerea Reeve, Icon., vol. 3, pl. 22, fig. 124.

Cypraea cinerea Gabb, 1881, Journ. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 360.

The *Cypraea cinerea* is a common, small species of Cowry shell along the north coast of Panama and Costa Rica. Several small Cypraeas were collected from the Gatun sandstones of the Rio Blanco which cannot be distinguished from recent examples of *cinerea.*

Gatun Stage: Rio Blanco.

Cypraea almirantensis, n. sp. Plate 12, figure 9

Shell large, heavy and rather high; the outlines of the shell from below, the side and from above is nearly rectangular, but with the anterior extremity more pointed; the shell is high (about ½ that of the length), with nearly flat or slightly convex sides; dorsal surface convex, a deep depression or pit about the posterior 1-4 and low, but large tubercles on each side of the posterior sinus; aperture narrow, curved, with the lips coarsely but regularly dentate (about 20 on each lip); posterior sinus is long and vertical; anterior sinus small and rounded; basal surface flat.

Length 60, basal diameter 39, vertical diameter 30 mm.

This is a species but distantly related to the *C. Henkeni* Sowerby, differing by its longer and higher shell, straight sides and smaller dorsal tubercles. The aperture is strongly curved and very deep on the posterior extremity, ending in the long, vertical sinus.

Gatun Stage: Water Cay, Panama.

Genus **STROMBUS** Linnæus

Strombus gatunensis Toula Plate 13, figures 5, 6

Strombus gatunensis Toula, 1909, Jahrb. der K-K Geol. Reichsanstalt Wien, vol. 58, p. 673, pl. 25, fig. 7.

Strombus gatunensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 355, pl. 26, figs. 3, 5.

But two species of *Strombus* are known from the Gatun beds of Panama and Costa Rica, while five species occur in the synchronous Miocene strata of Santo Domingo and four in Jamaica. Other species may therefore be expected with further exploration work in Costa Rica.

In *S. gatunensis*, the coiling of the whorls follow closely the shoulder angle so that the last whorl appears very large and the spire low but wide. Young shells occasionally have the shoulder armed with few, large tubercles which later become nearly covered by the close coiling and appressed sutures. The last whorl is large, nearly smooth and with a rounded shoulder angle.

Occasionally traces of the original coloration is preserved and consists of narrow, yellow V-shaped lines, the acute base of which are directed backwards or away from the aperture and lie along the center of the whorls. Similiar markings may be seen on *Veatchi* and Guppy* has described the same markings for *pugiloides* from Jamaica. Length 63, diam. 42 mm.

Gatun Stage: Gatun, C. Z.
Water Cay, Panama.
Headwaters of Middle Creek, C. R.

Strombus pugiloides Guppy Plate 13, figures 1, 2, 3

Strombus pugilis Guppy, 1866, Quart. Geol. Soc. London, vol. 22, p. 287.

Strombus pugilis Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 233.

Strombus pugiloides Guppy, 1874, Geol. Mag., new series, vol. 1, p. 433.

Strombus pugilis Gabb, 1881, Journ. Acad. Nat. Sci. Phila., vol. 8, p. 340.

Strombus pugilis Bose. 1906, Boll. de Inst. Geol. de Mexico, numero 22, p. 35, pl. 4, figs. 1-6.

Strombus pugiloides Maury, 1917, Bull. Amer. Pal., vol. 5, p. 284, pl. 20, fig. 6.

A smaller species than the *gatunensis*, from which it also differs by its longer spire and more strongly sculptured shell. The coiling follows below the shoulder of the whorls, which is either simply rounded or bears several large, spine-like tubercles as in the recent *pugilis*. Resting stages develop large, hump-like areas irregularly distributed on the spire-whorls. Varieties occur which may be spirally sculptured over the whole shell or the last whorl may be largely smooth. The original coloration is still preserved on some shells and consist as in *gatunensis* of narrow, yellow, V-shaped lines, the apex of which lie about the middle of the shell and directed backwards. It is very distinct from the recent West Indian *pugilis*, which does not appear to descend below the Pliocene.

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* Proc. Sci. Assoc. Trinidad, 1873, vol. 2, p. 82, (reprint: Bull. Amer Pal., vol. 8, p. 214).

Uscari Stage: Sapote, C. R. (*Gabb*)
Gatun Stage: Banana River.
Zone E, Saury Creek.
Zoni 5, East Grape Point Creik.

Genus CREPITACELLA Guppy

Crepitacella limonensis, n. sp. Plate 15, figure 17

Shell small, melanoid in form, with a large body-whorl and shorter conic spire; nucleus of 2 small, smooth whorls followed by 5 post-nuclear whorls; sutures distinct; the whorls are slightly coronated and crossed by oblique and slightly curved riblets which become headed on the coronate edge of the spire-whorls just below the upper sutures; on the last whorl, the ribs do not pass below the middle; the surface is covered with faint spiral threads, most distinct on the base of the body-whorl; aperture elliptical, with a thin, oblique outer lip and a subobsolete anterior canal; pillar straight.

Height 8, diameter 4.5, aperture 4 mm.

The Costa Rican shell, although possibly not mature, is much smaller than the *C. cepula* Guppy from the Miocene of Venezuela and Santo Domingo of the same number of ribs. It differs also in having but 2 nuclear whorls, while *cepula* has 3. The coronation of the whorls which is such a striking feature of the Dominican shell, is very much less and inconcpicuous. The longitudinal costæ are more numerous and produce a fine circle of beads as they cross the small coronate edge of the spire-whorls.

Gatun Stage: Port Limon,
Boras del Toro.

Genus CERITHIUM Adanson

Cerithium costaricensis, n. sp. Plate 10, figure 28

Shell with a long, slender spire of about 12 whorls (tip broked); sutures deep but somewhat appressed; the profile of the spire-whorls is convex with an occasional hump-like resting mark; the sculpture consists of primary spiral threads between which lie 1, 3, or more finer secondaries; the earlier spire-whorls have heavy ribs but they become replaced on the later by simple granulations on the primary spirals; a narrow, sloping band borders the anterior side of the suture and carries finer, non-beaded spiral threads: below this band, the later spire-whorls bear about 4 beaded, primary spirals and finer secondaries; the last whorl shows 6 primaries together with other spirals on the base and canal; aperture subcircular, with a moderately expanded outer lip, obliquely produced anteriorly.

Height 28, diameter 10.5, aperture 8 mm.

The general form and sculpture of this species is that of the recent West Indian *C. eburneum* Bruguiere. The fossil shell is larger, more slender and differently sculptured.

Gatun Stage: Coll. 6, Red Cliff Creek.

Genus **CLAVA** Martyn

Clava costaricana, n. sp. Plate 10, figures 3, 4

Shell of medium size, cerithoid; whorls about 15, the early spire-whorls very small; the last whorl carries a large hump on the ventral side of the shell to the right of the aperture, so that the shell appears flattened on this side; the sculpture consists of strong spiral cords which are coarsely granulated by small, closely spaced longitudinal costæ; the upper spiral cord bordering the suture is somewhat larger than the other; there are 3 spirals between the sutures of the spire-whorl and 6 on the last whorl with additional smaller ones on the base of the shell; the outer lip is broken on all our specimens; the columella carries 2 strong folds.

Height 40, diameter 15 mm.
41, 14 mm.

This species bears some resemblance to the *C. caloosaënsis* Dall from the Pliocene of Florida. The Costa Rican shell is very much larger, broader and the longitudinal costæ are more rib-like, continued across the whorls, crossing the interspaces as well as the spiral cords.

Gatun Stage: Banana River.

Clava alajuela, n. sp. Plate 10, figure 30

Shell small, slender; whorls 12 plus, the apex broken; the sides of the whorls are straight and form the narrow, tapering spire; sutures indistinct; the sculpture consists of nearly equal ribs and spiral threads; the early spire-whorls have 3, equal, spiral threads, separated by interspaces as wide as the spiral threads and deep; on the later whorls fine, intermediate threads appear in the interspaces and a fourth large spiral in the lower suture; the spirals are crossed and strongly beaded by straight or slightly curved, longitudinal ribs, which number on the last whorl about 25 or 24; heavy and thickened resting marks appear on the later whorl on each volution; the aperture is broken, the columella straight and with a single small fold.

Height 17 mm, diameter 6 mm.

A small and finely sculptured species, represented by the single type specimen.

Gatun Stage: Middle Creek.

Genus **SERPULORBIS** Sassi

Serpulorbis papulosa Guppy Plate 12, figure 1

Vermetus papulosus Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p. 292, pl. 17, fig. 3.

Vermetus papulosus Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 32, p. 519.

Sespulorbis papulosa Maury, 1917, Bull. Amer. Pal., vol. 5, p. 291, pl. 22, fig. 10.

Considerable variation may be seen in the Costa Rican shells, from specimens in which the sculpture is quite coarse and with the interspaces between the main cords carrying only one strong intermediate cord, to more delicately sculptured forms with finer tuberculated cords separated by wide and finely sculptured interspaces.

This species occur also in the Bowden beds of Jamaica and in the Gurabo formation of Santo Domingo.

Gatun Stage: Hill 1, 2, Banana River.

Genus **PETALOCONCHUS** H. B. Lea

Petaloconchus sculpturatus, H. C. Lea Plate 14, figures 10, 15

Petaloconchus sculpturatus H. C. Lea, 1845, Trans. Amer. Phil. Soc., vol. 9, p. 233, pl. 34, fig. 3.

Petaloconchus domingensis Sowerby, 1849, Quart. Journ. Geol, Soc. London, vol. 5, p. 51, pl. 10, fig. 8, a b c.

Pataloconchus sculpturatus Gabb, 1875, Trans. Amer. Phil. Soc., vol. 25, p. 240.

Pataloconchus sculpturatus Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 32, p. 519.

Vermetus (*Petaloconchus*) *sculpturatus* Dall, 1892, Trans. Wagner Free Inst. Sci., vol. 3, pt. 2, p. 305.

Vermetus (*Petaloconchus*) *pulcher* Bose, 1906, Bol. Inst. Geol. de Mexico, Numero 22, p. 32, pl. 3, figs. 22, 23.

Petaloconchus domingensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 359.

Petaloconchus domingensis Pilsbry and Brown, 1917, Proc. Acad. Nat. Sci. Phila., vol. 69, p. 37.

Pctaloconchus domingensis Maury, 1917, Pull. Amer. Pal., vol., 5, p. 292, pl, 22, fig. 11.

Pataloconchus domingensis Hubbard, 1920, New York Academy of Science, Sci. Sur. P. R., vol. 3, pt, 2, p. 139.

The Antillean fossil was described by Sowerby as *domingensis*. It has been by some writers, considered synonymous with *sculpturata*, described a few years earlier by H. C. Lea from the Chesapeake Miocene of the eastern United States, while others have given *domingensis* the rank of a full species. A close comparative study of the Costa Rica fossils with several sets of typical *sculpturata* reveals no distinction between them. Both are variable in their coiling from closely wound, narrow cylinders to more open, umbilicate coils. The sculpture is much the same.

In the United States, this fossil is limited to the Upper Chesapeake Miocene. In the Antillean and South American regions, it is found in the Bowden beds of Jamaica, the Gurabo formation of Santo Domingo, the Quebradillas limestone of Porto Rico, the Springdale beds of Trinidad, from the Gatun beds near Cartagena, Colombia and Mexico.

Gatun Stage: Gatun Stage, C. Z.
Water Cay, Panama.
Coll. 4, 5, East Grape Point Creek.
Comadre Creek.

Genus **SILIQUARIA** Lamarck

Siliquaria modesta Dall, var. **limonensis**, n. var, Plate 12, figure 4, 5, 6

cf *Siliquaria modesta* Dall, Mus. Comp. Zool., vol. 9, p. 39.

cf *Siliquaria modesta* Dall, 1889, Bull. Mus. Comp. Zool., vol. 18, p. 260, pl. 26, fig 4.

This shell is very abundant in certain marly and sandy beds in the coralline limestones of the Limon Peninsula and elsewhere. Specimens in perfect condition are very difficult to obtain, the shell being very fragile and delicate. There are no longitudinal threads and the shell is smooth, except for the growth lines which are sometimes a little irregular.

We have associated this shell with the *S. modesta* of Dall, a recent species and recorded by Dr. Dall from several stations in the West Indies and the Gulf of Mexico, in waters ranging from 94 to 805 fathoms in depth. The fossils differ in being more loosely coiled and at the later stages long drawn out.

Dr. Maury's *S. guarabensis* from the Miocene of Santo Domingo is more irregular in its habitus of growth and the surface of the shell carries faint longitudinal threads. Gabb has described as *sculpturata* a *Siliquaria* from the Limon Peninsula. This is united by Dall with the recent West Indian *squamata* Blainville. I have seen no spicimens and Gabb may have collected it from the true Pliocene beds of the Limon Peninsula.

Gatun Stage; Island of Bocas del Toro.
Port Limon.

Genus **TURRITELLA** Lamarck

Turritella gatunensis Conrad Plate 14, figures 12, 13

Turritella gatunensis Conrad, 1857, Pacific R. R. Report, vol. 6, p. 72, pl. 5, fig. 20.

Turritella conradi Toula, 1909, Jahrb. der K-K Geol. Reichsanstalt, vol. 58, p. 694, pl. 25, fig. 4.

Turritella gatunensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, pl. 27, figs. 4, 5, 9.

The *Turritella gatunensis* is a medium sized shell seldom over 40 mm in length. The base of the whorl overhangs the next, and each whorl is encircled by a median concave or constricted band. The whole surface it finely sculptured with small spiral threads. The spirals defining the median band are usually slightly heavier as well as a few about the upper part of the base.

The *T. gatunensis* is a common and widely distributed species in the Gatun beds, but always less abundant than the *T. altilira* or its varities. Like the *altilira*, zones of *T. gatunensis* are frequent in some localities.

The *T. atacta* Dall of the Tampa Silex beds, the *T. acropora* fossil in the Pliocene of Florida and recent along the east coast of United States and the West Indies, are related species.

Gatun Stage: Gatun, C. Z.
Water Cay, Panama.
Boucary Creek, C. R.

Turritella mimetes Brown and Pilsbry Plate 14, figure 5

Turritella mimetes Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 357, pl. 27, fig. 1.

Turritella (*Haustator*) aff. *Hanleyana* Reeve - *T. lineolata* (Kiener) Toula, 1911, Jahrb. der K-K Geol, Reichsanstalt, vol. 61, p. 401, pl. 30, figures 6a and 6b,

A large, robust species in form and sculpture like the *T. variegata* Linnæus, recent in the West Indies.

The whorls are straight and usually slightly overhanging the lower sutures. Surface sculptured with primary, secondary and tertiary spiral threads. The primary threads are irregularly disposed and usually number about 7 or 8 to each whorl. Between the primaries are the finer secondaries and tertiaries.

Small shells may be mistaken for the *gatunensis*, but the whorls are flat, without the median concave and constricted zone and the sculpture is more coarse. The figured shell of 14 whorls has a length of 70 mm and a diameter of 18 mm. A larger but more imperfect specimen of but 4 whorls measures:

Length 50, diameter 20 mm.

Gatun Stage: Gatun, C. Z.

Turritella altilira Conrad, and varities.

Turritella attilira Conrad, 1857, Pacific R. R. Reports, vol. 6, p. 72, pl. 5, fig. 19.

Turritella gabbi Toula, 1909, Jahab. der K-K Geol. Reichsanstalt, p. 695, pl. 25, fig. 5.

Turritella altilira Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 358, pl. 27, figs. 2, 3.

Of the species of *Turritella* in the Gatun beds of Costa Rica and Panana, the *T. altilira* of Conrad and its varieties is the most common and characteristic. The *T. tornata* Guppy, from the Miocene of Trinidad and Venezuela is a closely related species.

These magnificent *Turritellæ* are preminently characteristic of the West Indian and Caribbean Miocene, but probably derived from earlier forms in the Oligocene. The stock continued into the Pliocene where its acme of development was reached in the elegant *T. preattenuata* Heilprin of Florida. It has left no descendants in the recent fauna.

The shell is long and tapering, each whorl sculptured with 2 prominent beaded spiral cords, between which the surface is concave or deeply channeled and may be smooth or with finer spiral threads. The upper spiral cord is simple or double. Several varieties may be recognized which differ in details of their sculpture, size and form of shell.

T. altilira Conrad, typical Plate 14 figures 6, 7

This, the most elegant form is limited to the small Gatun sedimentary basin of the Canal Zone and the adjacent Province of Colon.

The shell is long, slender and with numerous whorls; each whorl is strongly sculptured by the two, primary spiral cords, each of which is bordered on adjacent faces by a smaller spiral, between which lies a deeply channelled groove; smaller beaded spirals occur in the median channel and are best developed on the spire whorls; the beading or granulation of the spirals is produced by the arcuated lines of growth, the sinus of which lies a little above the middle of the shell; the upper spiral cord is larger than the lower and more strongly beaded and in general becomes double on the later whorls.

Gatun Stage: Canal Zone and Province of Colon.

Var. **chiriquiensis**, n. var. Plate 14, figures 4, 8, 9, 14

Shell larger, less attenuated and more coarsely sculptured than typical *altilira*; the 2 spiral cords are less strong, of more nearly the same size and usually remaining simple; the 2 spiral cords enclose a wide, concave area of about ½ the width of the whorl; this concave band usually carries 2, 3, or more fine spiral threads; the beading or granulation of the spiral cords is feeble and best developed on the earlier spire whorls and in certain large, gerontic shells the spiral cords may become nearly smooth.

This is the common form on the islands of the Chiriqui Lagoon, and of eastern Costa Rica. Like the typical *altilira* it is often a very abundant fossil, forming zones of *Turritella* in the Gatun beds.

The sculpture is much less elegant than that of true *altilira*, and consists mainly of the 2, primary spiral cords, between which lies a wide concave band. This band is but feebly sculptured by small, spiral threads, or in some cases, is smooth.

In small matters of detail of sculpture and in the form and taper of the shells, there is considerable variation. Such variation is usually of but local signifieance and in general the shells collected at the same or nearby localities will agree closly with each other but differ more or less from those of more distant areas.

The *T. tornata* Guppy from the Miocene of Venezuela and Trinidad should probably be considered as a variety of *altilira*, most closely allied to the *chiriquensis*. Its sculpture is like *chiriquensis* but with stronger spiral threads on its median band.

Gatun Stage: Water Cay.
Grape Point and Red Cliff Creeks, C. R.
Banana River.
Rio Blanco.

Var. **costaricensis**, n. var. Plate 14, figure 11

Shell small; whorls less numerous and more rapidly increasing so that the shell is porportionately broader and shorter; sutures deep; the 2 primary cords are but weakly developed, between which lies, the concave band as in *chiriquiensis;* the band carries 3, 4, or more strong, irregular spirals, but slightly weaker than the primaries; the granulation of the cords is weak and irregular.

Much smaller than the preceding varieties (usually about 40 mm) and with wider and more rapidly increasing whorls. The cords on mature shells are small and but slightly heavier than the spiral threads on the concave band.

This type replaces the *chiriquiensis* in the Gatun sandstones in the area of Upper Hone Creek and Boucary Creek. It is often extremley abundant, associated with the *Turritella gatunensis.*

Gatun Stage: Upper Hone and Boucary Creeks.

Turritella exoleta Linnæus, var. **limonensis,** n. var. Plate 14, figs 2, 3

Shell turreted, the whorls increasing more rapidly in diameter than typical *exoleta;* the nucleus is small, immediately followed by whorls carrying a median carina which gradually becomes more anterior in position and later the lower carina of the adult sculpture; the whorls are deeply concave or excavated about the middle between 2 principal carinæ; on the last whorl there is seen to be a third carina which is concealed in the suture; the sutures are excavated, becoming generally deeper with age; the surface is nearly smooth, except for very faint spirals and rough growth lines which may be raised and sublamellose on the median concave zone.

Height 40 (6 later whorls) diameter 17.50 mm.
Height 35 (10 earlier whorls) diameter 10 mm.

This is probably a distinct species from the recent West Indian *Turritella exoleta* Linnæus, differing in its more rapidly expanding whorls. Faint spirals may generally be seen covering the entire shell and the growth lines become raised and sublamellose in the concave medial zone. It is a common shell in the coralline phase of the Gatun at Port Limon and elsewhere.

Gatun Stage: Port Limon.
Bocas del Toro.

Turritella oreodoxa, n. sp. Plate 14, figure 1

Shell large, solid and very slender; whorls numerous and each but slightly larger than the preceding, slightly concave or constricted about the upper 1-3, above which the edge of the whorl is enlarged, forming a cord-like expansion about the upper suture; sutures indistinct and appressed; sculpture of fine, irregular and somewhat wavy spiral lines and indistinctly alternating in strength; growth lines as typical for *Haustator* (not visible on the base of our specimen), commence at the lower suture and pass straight and parallel to the longitudinal axis of the shell to the middle of the whorl where they become bent and continue obliquely to the left or towards the aperture to the upper suture.

Length (2½ whorls), 49, diameter 23 mm.

A very rare species and represented in our collection by only two imperfect specimens. It appears to be closely related to the *T. cartagensis* Pilsbry and Brown from the Gatun of Colombia. The full-grown Costa Rican shell was probably longer and more attenuated and each whorl is prominently elevated or ridged just in front of the lower suture.

Gatun Stage: Rio Banana beyond Hill No. 5.

Genus **ALABA** A. Adams

Alaba turrita Guppy, 1896, Proc. U. S. Nat Mus., vol. 19, p. 321, pl. 28, fig. 7.

Guppy's figure of his type specimen from Jamaica agrees very closely with our specimen from the Estrella River. The whorls are finely spiralled with low ridges which are obsolete from the upper parts of the whorls. Each whorl carries 2 or more broad, smooth varices formed during resting stages. The last whorl is strongly angulated by these varices.

Height 5, diameter 2.25 mm.

Gatun Stage: Coll. 7, Estrella River.

Genus **ARCHITECTONICA** Bolton

Architectonica granulata Lamarck Plate 13, figure 10 ,11, 12

Solarium granulatum Lamrack, 1822, An. sans. Vert., vol. 7, p. 3,

Architectonica prespectiva Tuomey and Holmes, 1857, Pleioc. Fos. S. C., p. 120, pl. 26, fig. 6.

Solarium granulatum Dall, 1892, Trans. Wagner Free Inst. Sci., vol. 3, pt. 2, p. 329.

Solarium Villarelloi Bose, Inst. Geol. de Mexico, Numero 22, p. 30, pl. 3, figs. 4-11.

Solarium gatunense Toula, 1908, Jahrb, der K-K Geol. Reichsanstalt, Wien, vol. 58, p. 693, pl. 25, fig. 3.

Solarium granulatum Maury, 1917, Bull. Amer. Pal., vol. 5, p. 295, pl. 23, fig. 3.

The Costa Rican fossils are usually quite typical and not to be distinguished from recent examples of *granulata*. They vary somewhat in their height and persistence of their spiral sculpturing. The beaded and granulated character of the spirals generally becomes obsolete on the later whorls so that the spiral bands appear smooth. The umbilicus is deep but narrow.

This is a stable species ranging from the lower Miocene to the recent. Its recent distribution extends from Cape Hatteras on the north, southward through the West Indies and on the Pacific side from the Gulf of California to Peru.

Height 20, greater diameter	43 mm.
19,	29 mm.
12.75	20 mm.

Gatun Stage: Gatun, C. Z.
Water Cay, Panama.
Coll. 2, Rio Cocles.
Banana River.
Rio Betey.

Genus **NATICA** Scopoli

Natica canrena Linnæus Plato 13, figure 9

Natica canrena Linnæus, 1758, Syst. Nat., ed. 10, p. 776.

Natica canrena Gabb, 1881, Journ. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 357.

Natica canrena Brown and Pilsbry, 1912, Proc. Acad. Nat. Sci. Phila., p. 508,

Natica canrena Maury, 1917, Bull. Amer. Pal., vol. 5, p. 298, pl. 23, fig. 10.

This is a recent species but also common as fossil in the Miocene of the West Indies and the States. It is a warm water species so that in the Chesapeake Miocene of the eastern United States, it is found only in the warm, upper or Duplin stage. We collected several specimens at Gatun but none at Costa Rica. Gabb however has recorded it as abundant from the Limon Peninsula but whether his specimens were obtained from the Miocene or Pliocene is not known.

The species is distinguished by its strong, tangential, sutural plicæ, but the main surface of the whorl is otherwise smooth.

Gatun Stage: Gatun, C. Z.

Natica Youngi Maury, var., **cocleana**, n. var. Plate 13, figure 8

cf. *Natica Youngi* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 299, pl. 23, figs. 11, 12.

Shell subglobular with 5 rounded and convex whorls; surface smooth but with irregular, coarse growth lines about the sutures; the surface is also faintly straited with weak spiral lines as may be seen on several otherwise smooth Naticas; aperture semilunar with a narrow callus on the inner lip, slightly thicker about opposite the middle of the umbilicus; umbilicus small, with the umbilical callus small and but poorly developed.

Length or height 25, diameter 34 mm.

A single specimen from the Gatun of Cocles Creek. It agrees almost exactly with Dr. Maury's type specimen of *Natica Youngi* from the Miocene of Santo Domingo in size and form, but differs in its smaller umbilicus and smaller umbilical callus. The Costa Rican shell has the aspect of a *Neverita*.

Gatun Stage; Cocles Creek, near Old Harbor, C. R.

Section STIGMAULAX Moerch

Natica Guppyana Toula Plate 13, figures 13, 14, 15

Natica (*Stigmaulax*) *Guppyana* Toula, 1909, Jahrb. der K-K Geol. Reichsanstalt, Wien, vol. 58, p. 696, pl. 25, fig. 6.

Natica Guppyana Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 360.

This species stands intermediate in its sculpture and form to the *N. canrena* Linnæus and *N. sulcata* Born, both recent and fossil Miocene species. In *Guppyana*, the sculpture consists of even, wide and deep sulcations, which cross the face of the whorl from the upper suture to the umbilicus. They are in fact the continuation of the tangential sutural plicæ of *N. canrena*. With further growth these sulcations may become obsolete on the middle of the whorls until they are lacking from the greater part of the shell except in the immediate vicinity of the upper sutures and on the umbilical angle. This change in sculpture is not seen to the same extent on all shells and some specimens may remain strongly grooved and sulcated even when large and mature. In other cases (in general with shells from the Banana River) only very young shells have the sulcation continuous across the face of the whorl, but soon become smooth, leaving the plications only about the upper suture and on the umbilical angle. Such shells resemble closely *N. canrena*, but in addition to the grooving of the umbilical angle, have a larger and more exanded aperture.

The *N. sulcata* Born still remains to be found in Costa Rica and Panana. It is abundant as a Miocene fossil in Santo

Domingo, Jamaica and Venezuela. It differs from the *Guppyana* by its closer and more irregular longitudinal sculpture crossed by faint spirals, producing a cancellated appearance. The umbilicus is larger and more ample.

Gatun Stage: Gatun, C. Z.
Water Cay, Panama.
Banana River, C. R.

Genus **POLINICES** Montfort

Polinices subclausa Sowerby Plate 13, figures 16, 17

Natica subclausa Sowerby, 1849, Quart. Journ. Geol. Soc. London, vol. 6, p. 51.

Natica subclausa Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p. 290, pl. 18, fig. 8.

Polinices subclausa Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Philia., vol. 63, p. 560.

Polinices subclausa Maury, 1917, Bull, Amer. Pal., vol. 5, p. 300, pl. 23, fig. 14.

This is a common fossil in the Miocene of Santo Domingo and Jamaica. The Costa Rican shells are small, the largest specimen in our collection measuring only 17 mm in altitute.

When viewed from the dorsal side, the shell has a distinctly *Nerita*-like aspect, due to its low spire, close coiling and rapidly enlarging whorls and appressed sutures. The umbilicus is of medium size, expanding below. The inner lip is provided with a thick, heavy callus which joins above with the outer lip. At the upper edge of the umbilicus, the callus carries a deep, transverse groove, a most characteristic feature.

Gatun Stage: Gatun, C. Z.
Hill No. 3, Banana River, C. R.

Polinices Stanislas-Meunieri Maury Plate 13, figure 7

Polinices Stanislas-meunieri Maury, 1817, Bull. Amer. Pal., vol. 5, p. 300, pl. 23, figs. 15, 16.

The Banana River beds contain a large species of *Polinices* which appears to be this Dominican species. It differs from the recent *mammillaris* Lamarck, of the Costa Rican and Panana coast by its much narrow umbilicus. Its surface is lined with very fine spiral threads.

Young shells may be mistaken for the *subclausa* which occurs in the same beds, and careful study is sometimes necessary for their separation. The present shell is less heavy, with a higher spire and more convex spire whorls. The umbilicus is much narrower, and a smaller callus on its inner lip which shows but faintly the transverse groove. The surface of *subclausa* is smooth, but in *Stanislas-Meunieri* very finely lined with minute spirals.

Gabb has described from Sapote, Costa Rica, a *Natica eminuloides* which in form resembles young shells of the *Stanislas-Meunieri*. His figure shows a different shaped umilicus and no transverse groove on the callus of its inner lip.

Length or altitute 44, diameter 38 mm.

Gatun Stage: Hill 1a 2, 3, Banana River, C. R.

Subgenus **NEVERITA** Risso

Neverita nereidis Maury

Neverita nereidis Maury, 1917, Bull. Amer, Pal., vol. 5, p. 301, pl. 23, figs. 17, 18.

Our collection from ths Lower Gatun of Red Cliff Creek, contains a fragment of this very interesting species. The *N. nereidis* described by Dr. Maury, from the Cercado formation of Santo Domingo, is closely allied to the recent West Coast *N. glauca* Humboldt. The Miocene *N. nereidis* is less broad, with a narrower umbilicus and a larger umbilical callus.

Gatun Stage: Coll. 6, Red Cliff Creek, C. R.

SUB-ORDER SCUTIBRANCHIATA

A. SUPER-FAMILY RHIPIDOGLOSSA

Genus **NERITINA** Lamarck

Section **SMARAGDIA** Issel

Neritina viridemaris Maury Plates 15, figure 22

Neritina viridis Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 242, Not *N. viridis* Linnæus.

Neritina (*Smaragdia*) *viridemaris* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 316, pl. 24, fig. 11.

The Costa Rican specimens are a little smaller than typical *viridemaris* from the Miocene of Santo Domingo; but are identical in other respects. They still retain their original coloration of a pale sea-green marked with straight and zigzag black lines. It is the Miocene precursor of the common, recent West Indian and Caribbean *N. viridis* Linné.

Gatun Stage: Coll. 5, Red Cliff Creek.
Middle Creek.

Genus **CREPIDULA** Lamarck

Crepidula plana Say

Crepidula plana Say, 1822, Journ. Acad. Nat. Sci. Phila., vol. 2, p. 226.

Crepidula plana Dall, 1892, Trans. Wagner Free Inst. Sci., vol. 3, pt. 2, p. 358.

Crepidula plana Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 360.

This common and well-known species has been recorded by Brown and Pilsbry from the Canal Zone. We have a single specimen from Water Cay, found in the interior of the specimen of *Solenosteira Vaughani* var. *medioamericana*. This species first appears in the Lower Miocene and has continued into the recent fauna.

Gatun Stage: Gatun (Brown and Pilsbry).

Genus **XENOPHORA** Fischer de Waldheim

Xenophora conchyliophora Born

Trochus conchyliophorus Born, 1778, Mus. Caes. Ind., p. 333.

Trochus agglutinans Lamarck, Anim. sans Vert., vol. 7, p. 14.

Phorus agglutinans Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 241.

Xenophora conchyliophora Dall, 1892, Trans. Wagner Free Inst. Sci., vol. 3, pt. 2, pp. 360-362.

Xenophora conchyliophora, Maury, 1917, Bull. Amer. Pal. vol. 5, p. 297.

One immature shell was collected from the upper Gatun beds of Old Man Sam Creek. It is one of the few species which has continued pratically unchanged from Upper Cretaceous times to the recent. It is rare as a recent shell along the northern Panama and Costa Rican coast. Gatun Stage.

Genus **PHASIANELLA** Lamarck

Phasianella mollis, n. sp.

Shell small, solid, ovate with a short, blunt spire and a small narrow umbilicus; whorls about 4, somewhat convex; suture distinct; surface smooth and usually showing no features; in some cases, color markings are preserved as brown, wavy blotches of flammules and with very faint suggestions of fine revolving lines which are so common on recent small *Phasianella.*

Height 3.25, diameter 2.75, aperture 1.50 mm.

The *Phasianella punctata* Gabb from the Miocene of Santo Domingo, has a longer spire and different color markings. It is much more like the recent *P. affinis* than the Costa Rican *mollis. P. mollis* is related to *P. umbilicata* d'Orbigny but differs in its sculpture.

The smaller forms of *Phasianella*, of which there are 2 or 3 species along the northern Costa Rican coast, are often extremely abundant on the rocks and reefs exposed to the heavy, pounding surf. There they are associated with a host of other gastropods, principal among which are several species of *Nerita*, *Fissurella*, *Purpura* and Chitons. The fossil shells therefore like the preceding *Neritina viridemaris* and several others which we have already called attention to, have drifted from some near-by rocky coast.

Gatun Stage: Coll. 5, Red Cliff Creek.
Middle Creek.

Genus **TURBO** Linnæus

Turbo saltus, n. sp. Plate 15, figure 12

Shell perforate, ovate-conic; spire high of about 6 convex whorls, separated by deep, canaliculate sutures; the last whorl is large and perfectly convex in form; sculpture consists of irregular, spiral cords or liræ; the earliest spire-whorls are strongly carinated by a single, strong spiral, above and below which the whorl is smooth; a second spiral appears above and the succeeding whorls of the spire have 2 principal spiral cords or liræ, and 9 smaller ones; the last whorl has three spirals that are a little stronger and many smaller ones of different sizes; the spirals are smooth; aperture perfectly circular, a small, spreading callus on the body-whorl just above the perforate base.

Height 17, diameter 15.5, aperture 7.5 mm.

Among the recent species of *Turbo* the *saltus* is related to the large *T. Spenglerianus* Gmelin,on one hand and to the smaller *T. filosus* Kiener on the other. The shell is perforate,in which character it approaches *T. filosus*, but the sutures are canaliculate or channeled as in the non-perforate *T. Spenglerianus*. The sculpture consists of irregular, smooth spiral cords or liræ of which 2 or 3 about the middle of the shell are a little larger than the others.

Gatun Stage: Coll. 5, Red Cliff Creek.

Genus **ASTRALIUM** Link

Astralium brevispinum Lamarck, var. **basalis**, n. var. Plate 15, figs. 4, 5

The *Astralium brevispinum* Lamarck is a recent species found living along the north coast of Panama and Costa Rica. It is most easily distinguished from the West Indian *A. longispinum* Lamarck by having its columellar area brilliantly stained with scarlet.

From upper Old Man Sam Creek in eastern Costa Rica, we collected a single specimen of an *Astralium*, very similiar in most of its characters to *brevispinum*. It differs most importantly in having a more strongly sculptured base. This sculpture consists of a wide, flat band, inside of which are 3, heavy, nearly equal spiral cords. The whole surface is crossed by squamose lines of growth.

Height 20, diameter 29.50 mm.

Gatun Stage: Coll. 6, Old Man Sam Creek.

Astralium caelatum Gmelin, variety

Trochus cælatum Gmelin 1792, Syst. Nat., p. 3581.

Astralium cælatum Pilsbry, 1888, Manual of Conch., first ser., vol. 10, p. 224, pl. 57, figs. 45, 46.

A large Turboid shell related to the recent *A. cælatum* Gmelin was collected from the coral limestones near Port Limon. It is so firmly imbedded in its rocky matrix that only a small portion of its surface is exposed to view. Its surface sculpture is like that of *cælatum*, but the radial costæ on the upper part of its whorl are closely spaced and not far apart as in the recent shell. Its height measures 55 mm, diameter 54.

Gatun Stage: Port Limon.

Genus **CHLOROSTOMA** Swainson

Subgenus **NEOMPHALIUS** Fischer

Chlorostoma costaricensis, n. sp. Plate 15, figure 16

Shell conoidal, solid, with a narrow, but deep umbilicus; suture distinct; the last whorl is strongly carinate or angled below; above this angle, the whorl is evenly convex, below, the base is nearly flat; the sculpture consists of beaded spiral cords, there being on the last whorl above the angled periphery 7 or 8 cords; the interspaces are nearly as wide as the cords, and are finely etched by oblique lines of growth and finer spirals; on the base, the spirals are irregular, the strongest about the middle; there are 2 or 3 cords about the upper part of the umbilicus, but the interior wall is smooth.

Height 10.5, diameter 16.5 mm.

The transitional beds between the Uscari and the Gatun of Red Cliff Creek, contain in addition to the usual fauna, several species, as certain Cerithoids, *Sistrum nodulosum*, *Modulus modulus*, *Nitidella* and the present species, whose normal habitat is on the rocks and reefs of the extreme, upper limit of the littoral zone. They are always much broken and worn as if they had been rolled and washed about by the surf on a rocky or sandy beach and then drifted out to the deeper and quiter waters off shore where depostion was going on.

Although all of our specimens of *C. costaricensis* are very fragmentary and much worn, we have deemed it best to place the species on record, as this subgenus has been recorded only very doubtefully from beds older than the Pleistocene.

Uscari Stage: Zone 6, Red Cliff Creek.
Gatun Stage: Zone 5, Red Cliff Creek.

Genus **CALLIOSTOMA** Swainson

Calliostoma limonensis, n. sp. Plate 15, figures 8, 11

Shell of medium size, conic; whorls about 8, flat or but slightly convex, so that the profile of the shell is a broad cone; sutures indistinct; the whorls are closely sculptured with fine, beaded spirals of primary and secondary orders; each spire-whorl has 7 or 8 primary spirals alternating with 1, 2 or 3 secondary; periphery sub-angular; base but slightly convex and closely spiralled with flat or sub-obsoletely beaded spirals (about 20), umbilicus narrow but deep, smooth within.

Height 19, diameter 18.5 mm.

Fairly abundant in the coral limestones along the shore west of Port Limon. Related to the recent *C. jujubinum* Gmelin, it differs by its more globose form and small, pointed attenuated apex.

Gabb has also described a small *Calliostoma* from the Limon Peninsular, as *C. Guppyana*. This shell of 8 or 9 whorls measures but 5 mm in height. It is a higher and more conic form with the whorls sculptured with beaded spirals.

Gatun Stage: Port Limon.

Calliostoma mancinella, n. sp. Plate 15, figures 9, 10

Shell of medium size; whorls about 8, with very indistinct sutures and a coarse sculpture of beaded spirals; the spire whorls are flat sloping evenly from the small projecting nucleus to the broadly rounded periphery of the last whorl; sculpture of the spire-whorls consists of about 6, strongly beaded spirals the largest of which bounds the upper sutures; between these spirals are scattered a few smaller ones, the lower half of the periphery and the base have about 12 additional spirals; these spirals are larger, more widely spaced and are smooth except the 4 or 5 around the umbilicus; the interspaces of the basal spirals are finely incised by minute longitudinal lines, corresponding to the growth lines; umbilicus narrow, but deep, smooth within; aperture rounded, with the outer lip strongly oblique.

Height 15, diameter 21 mm.

Several specimens of this well-marked species were obtained from the Gatun beds of eastern Costa Rica, in the vicinity of Manzanilla Point. In the Santo Dominican Miocene it is related to the *C. Grabaui* Maury, but the Costa Rican shell is much lower and more depressed.

The *C. Grabaui* and the *mancinella* belong to the group which contains the large, elegant *C. Sayana*, described by Dall from deep water off the Hatteras coast.

Gatun Stage: Coll. 4, East Grape Point Creek.
Headwaters of Middle Creek.
Coll. 5, Red Cliff Creek.
1 mile south of shore, along Old Man Sam Creek, (Veatch)

Calliostoma castilla, n. sp. Plate 15, figure 6, 7

Shell rather large, in form and sculpture resembling the *C. philanthropus* of the Chesapeake Miocene of eastern United States, but umbilicated; whorls 5 plus (apex broken), flat and forming a broadly conic spire; periphery of the last whorl, subangular, due to a broad, cord-like ridge, which appears as if formed form an overlapping of the base; sculpture of the spire-whorls of fine, alternating and beaded spirals, there being about 13 on each whorl; the base is nearly smooth the spirals being nearly obsolete or as broad low bands; the spirals about the umbilicus are slightly stronger and obscurely beaded; umbilicus deep and narrow.

Height 20, diameter 25 mm.

A large species with an angulated periphery, fine, beaded spirals above and a nearly smooth base. But a single specimen was collected from the coral limestones near Port Limon, associated with the common *limonensis*.

Gatun Stage; Port Limon.

CLASS SCAPHOPODA

Genus **DENTALIUM** Linnæus

Subgenus **DENTALIUM,** s. s.

Dentalium bocasensis, n. sp. Plate 15, figures 2, 3

Shell rather larger, solid, gently curved and increasing gradually in size; the tip is more curved than the rest of the shell and strongly hexagonal in cross-section; the sculpture consists at first of 6 strong, primary ribs and wide, flat or slightly concave interspaces; the ribs are further increased by the introduction of 6 intermediate ribs and still later by 12 more; these ribs are subequal in size on the later portions of the shell; the interspaces are finely transversely lined and faintly longitudinally striated.

Length 52, diameter 6.25 mm.
44, 4.75 mm.

The *Dentalium bocasensis* is fairly abundant in the shale beds of Bocas Island. It is recognized by its strongly hexagonal tip and finely transversely lined interspaces, and strong longitudinal sculpture.

Gatun Stage: Bocas del Toro.

Subgenus **FISSIDENTALIUM** Fischer

Dentalium uscarianum, n. sp. Plate 15, figure 1

Shell large, solid and heavy; gently curved, and the taper of the shell is slow and gradual; the tips are all broken on our specimens, but the later sections of the shell are circular or slightly compressed dorsal-ventrally; the surface is sculptured with about 24, low, subregular and rounded longitudinal ribs with smaller intermediate ones in the interspaces; the ribs become gradually obsolete with age and the later portions of full-grown shells are nearly smooth; fine transverse lines of growth cross the surface and are best seen on the earlier portions of the shell; operture oblique.

Length 60, diameter 12 mm.

This large *Dentalium* is abundant and very characteristic of certain conglomeritic zones in the Upper Uscari shales. There it occurs associated with a small but very distinctive fauna, including the *Ptychosalpinx*? *dentalis*, *Sconsia cocleana* and *Scaphella costaricana* and other species. When complete, the *Dentalium uscarianum* frequently reached a length of 110 mm or more.

All our specimens are unfortunately lacking in the apical tip. In general sculpture, it recalls the *Dentalium floridense* Henderson dredged from 35 to 110 fathoms of water off Florida and in the West Indies, but the taper of the shell is more gradual and the sculpture more irregular, becoming obsolete with age. Bose* has described a large species as *Dentalium rimosum* from the Miocene of the Tehuantepec Peninsula. In that species, the ribs number about 31, are very regular with deep interspaces, and ribs are finely etched by transverse lines of growth.

Uscari Stage: Coco Plum, Panama.
Rio Cocles.
Margarita—Old Harber trail.
Comadre Creek.
Pumbri Creek, etc.

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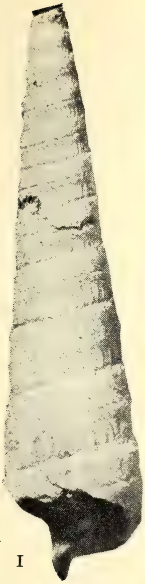
*Boll. Inst. Geol. do Mexico, No. 22, p. 55, pl. 3, figure 1, 1906.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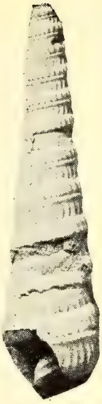
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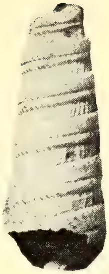
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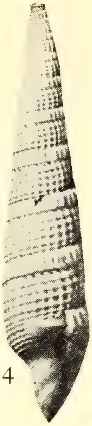
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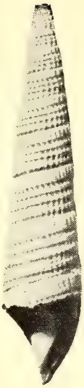
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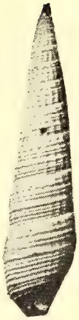
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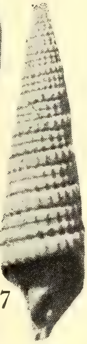
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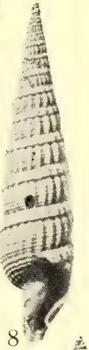
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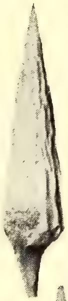
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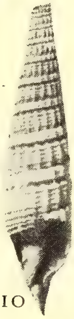
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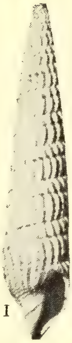
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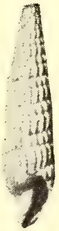
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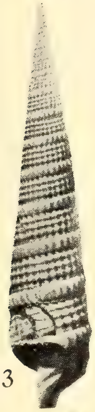
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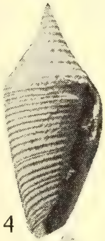
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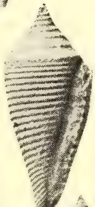
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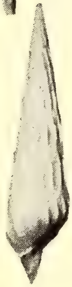
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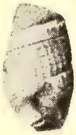
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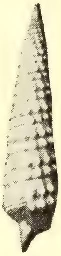
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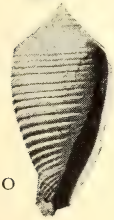
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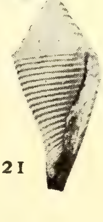
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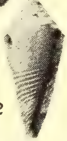
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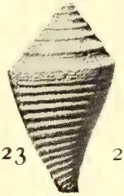
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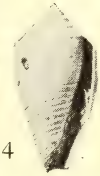
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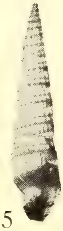
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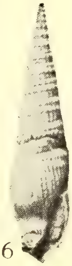
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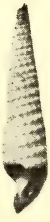
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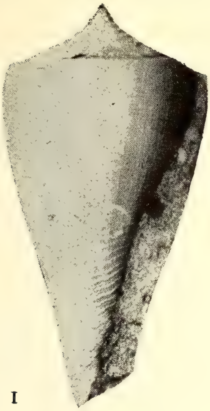
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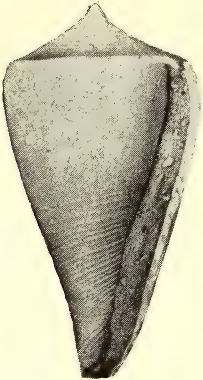
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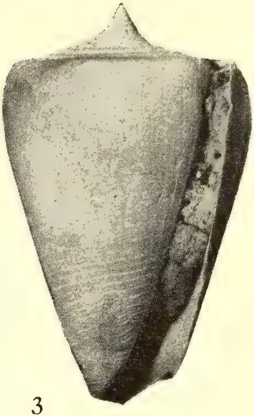
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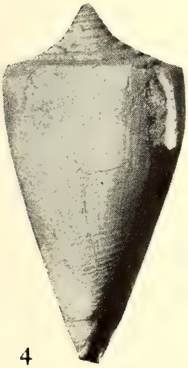
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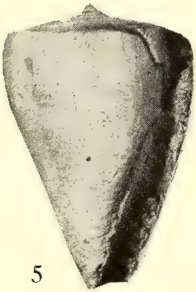
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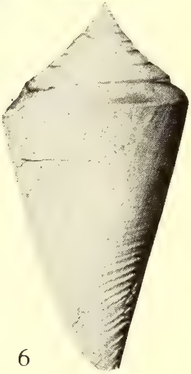
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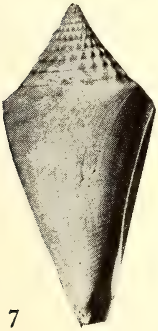
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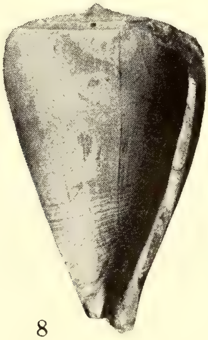
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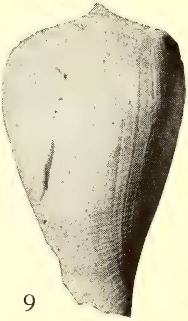
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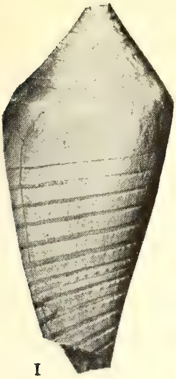
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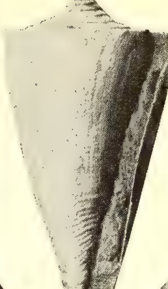
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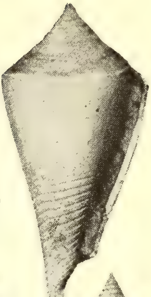
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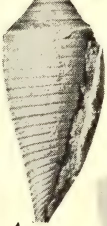
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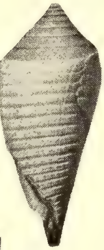
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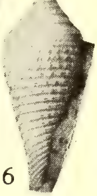
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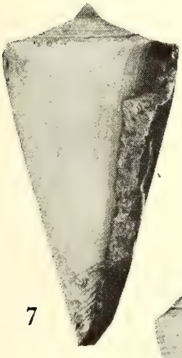
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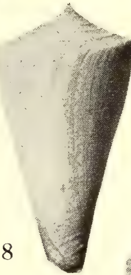
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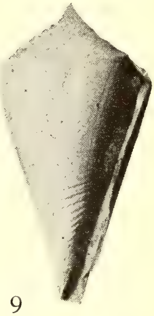
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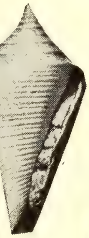
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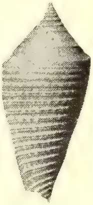
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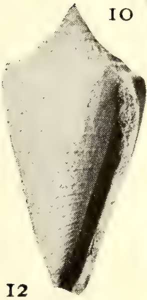
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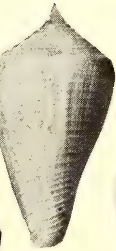
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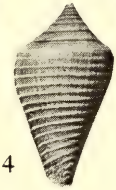
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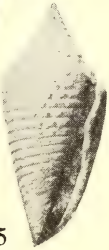
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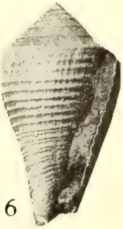
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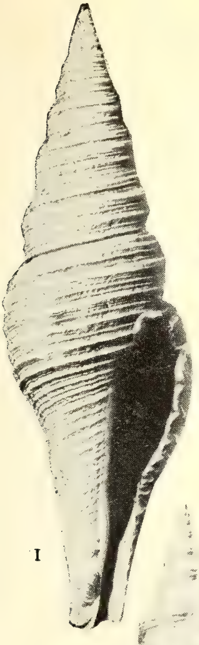
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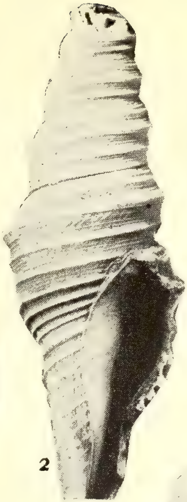
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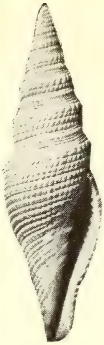
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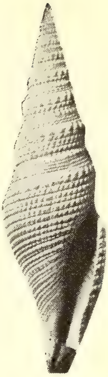
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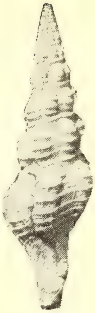
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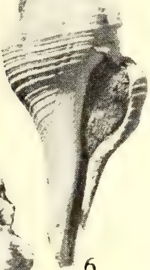
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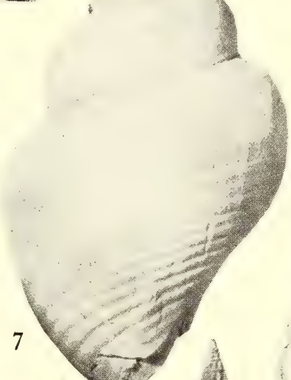
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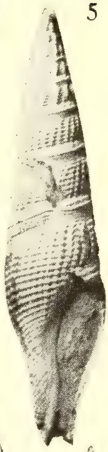
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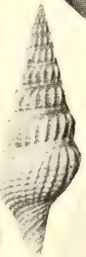
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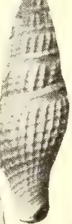
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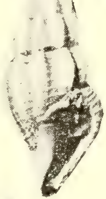
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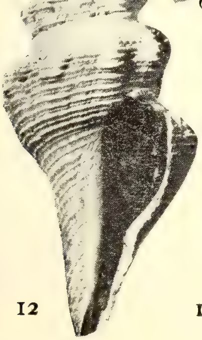
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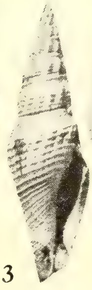
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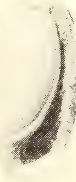
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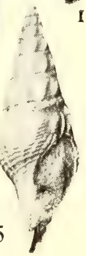
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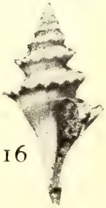
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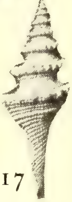
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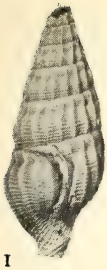
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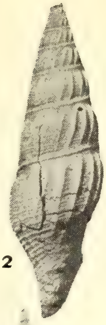
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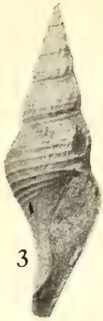
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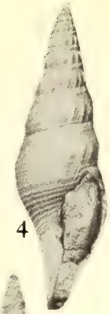
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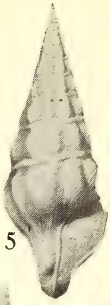
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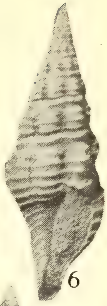
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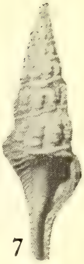
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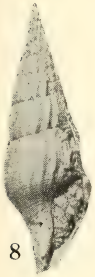
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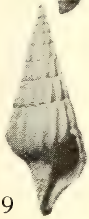
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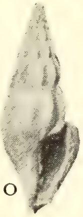
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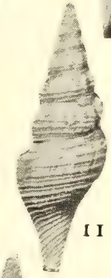
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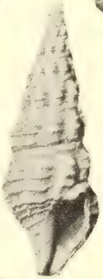
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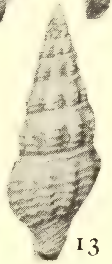
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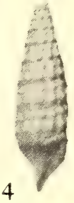
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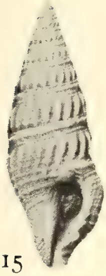
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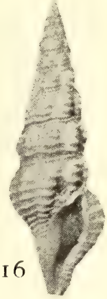
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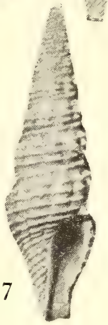
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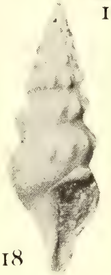
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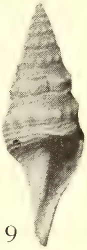
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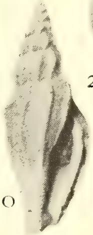
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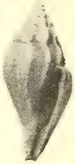
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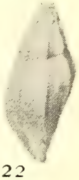
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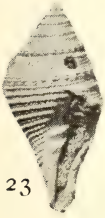
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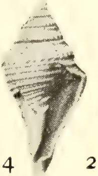
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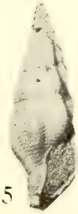
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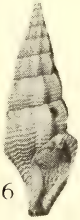
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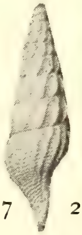
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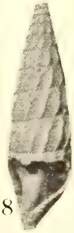
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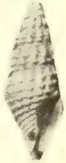
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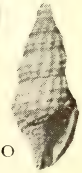
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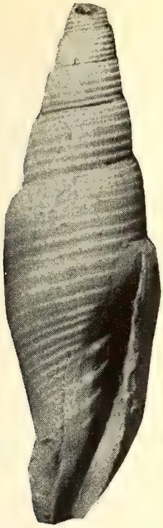
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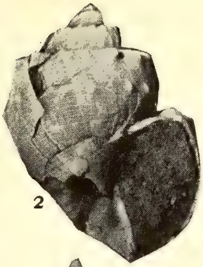
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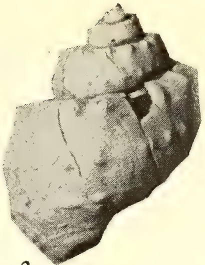
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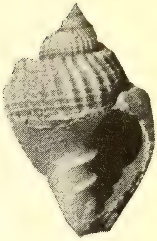
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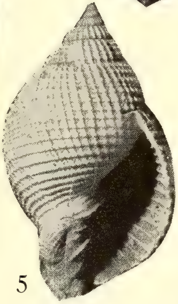
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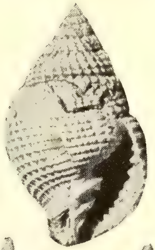
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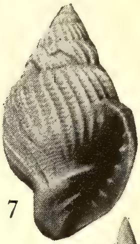
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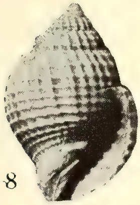
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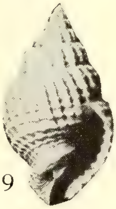
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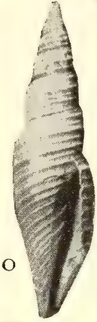
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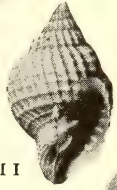
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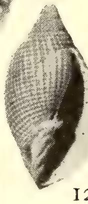
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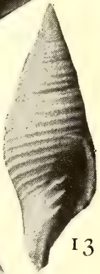
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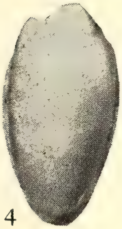
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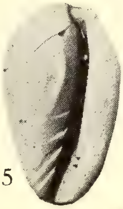
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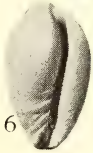
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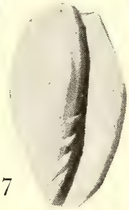
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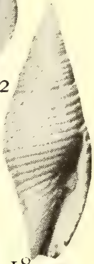
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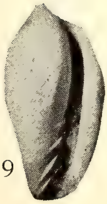
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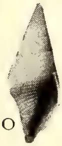
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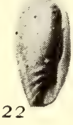
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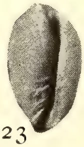
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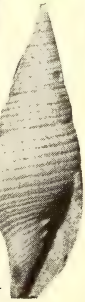
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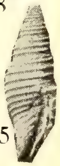
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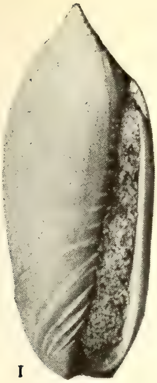
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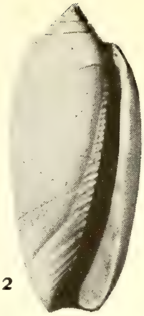
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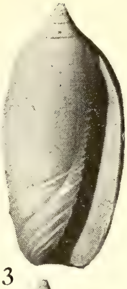
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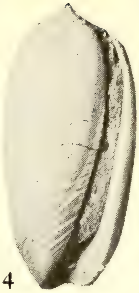
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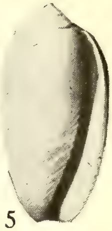
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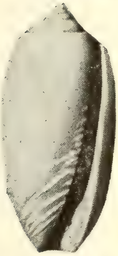
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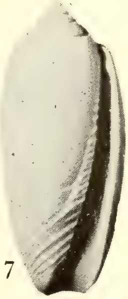
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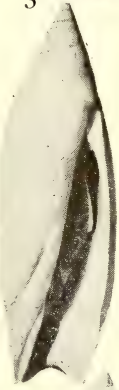
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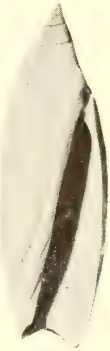
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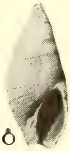
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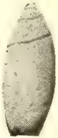
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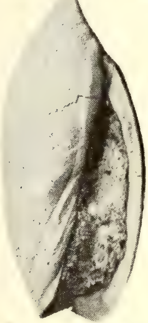
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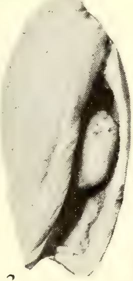
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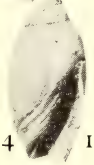
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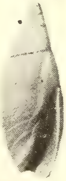
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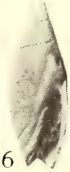
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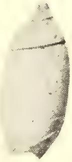
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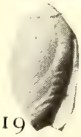
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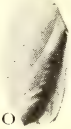
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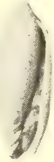
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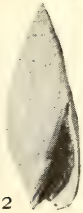
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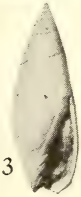
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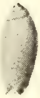
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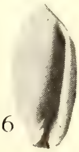
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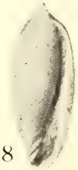
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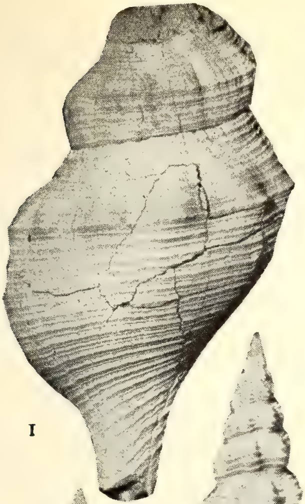
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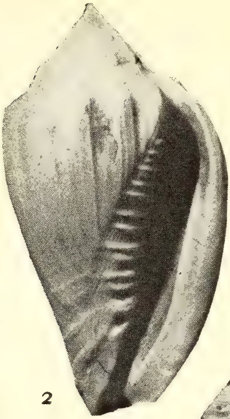
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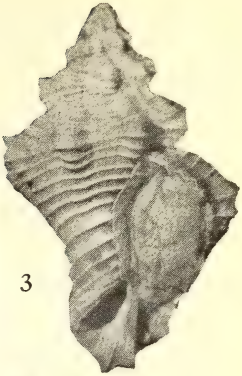
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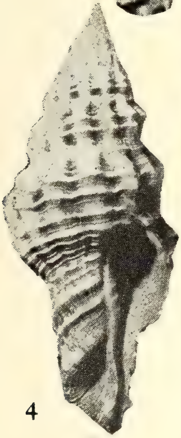
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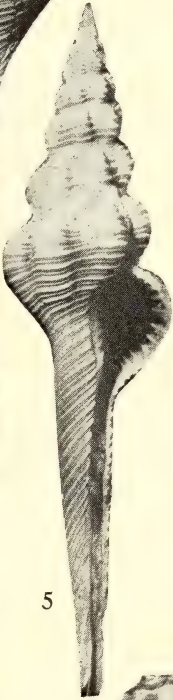
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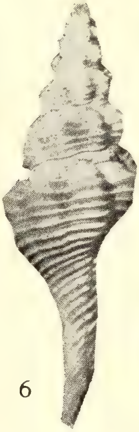
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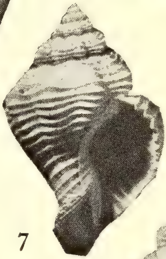
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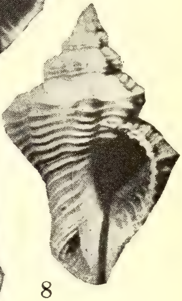
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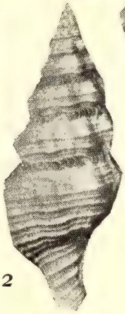
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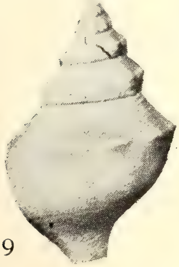
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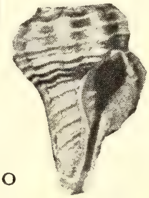
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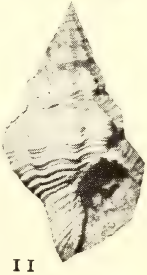
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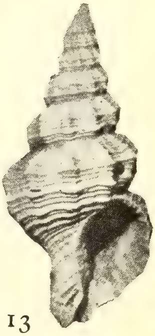
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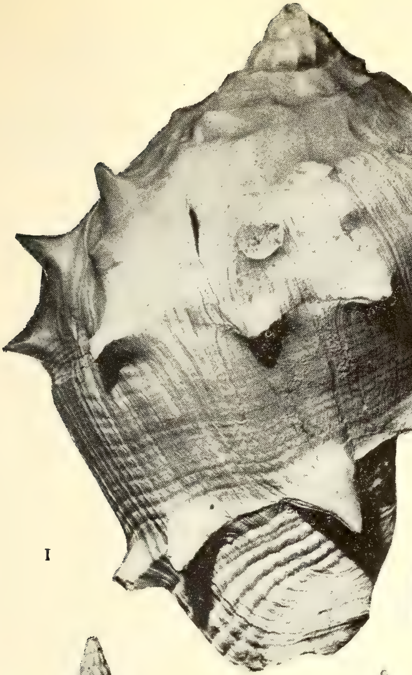
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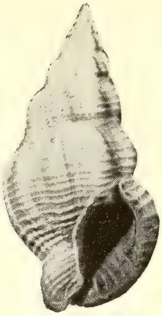
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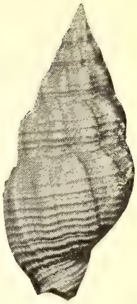
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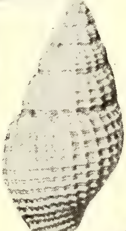
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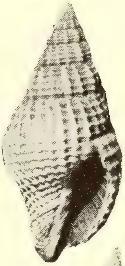
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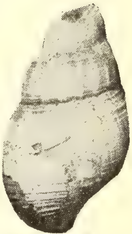
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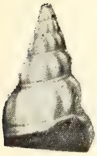
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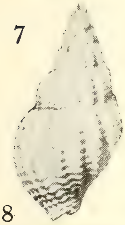
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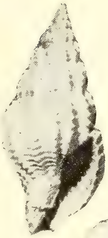
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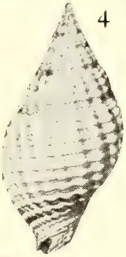
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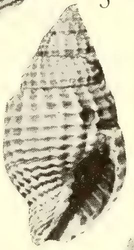
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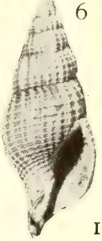
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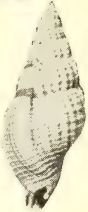
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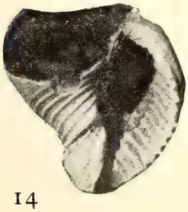
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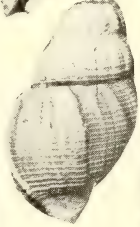
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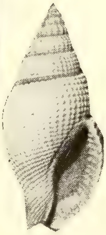
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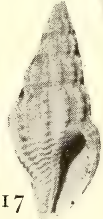
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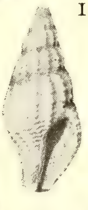
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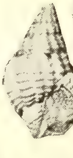
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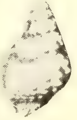
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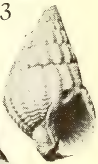
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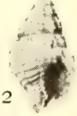
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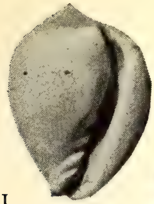
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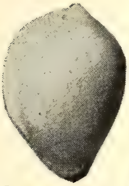
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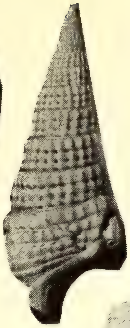
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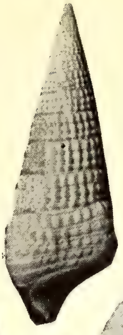
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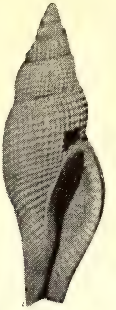
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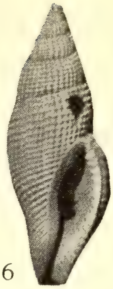
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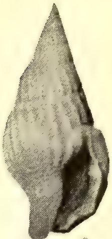
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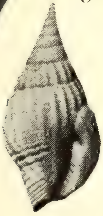
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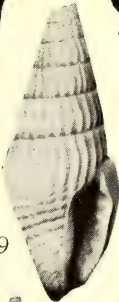
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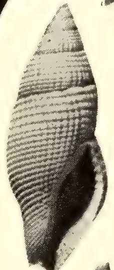
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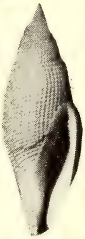
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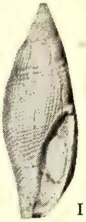
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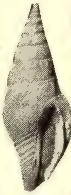
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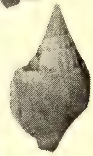
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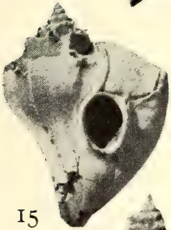
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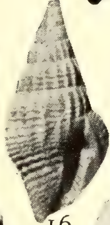
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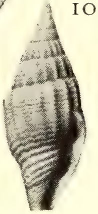
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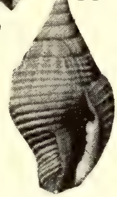
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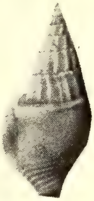
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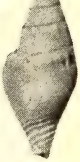
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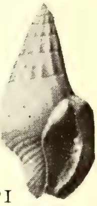
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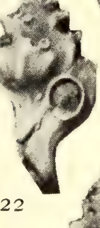
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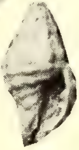
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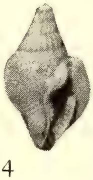
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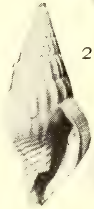
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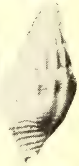
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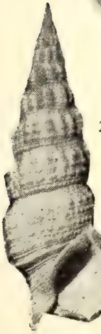
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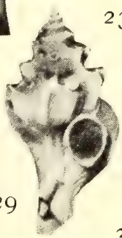
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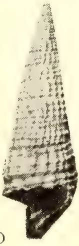
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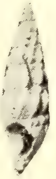
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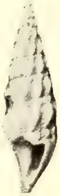
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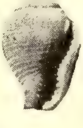
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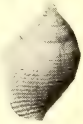
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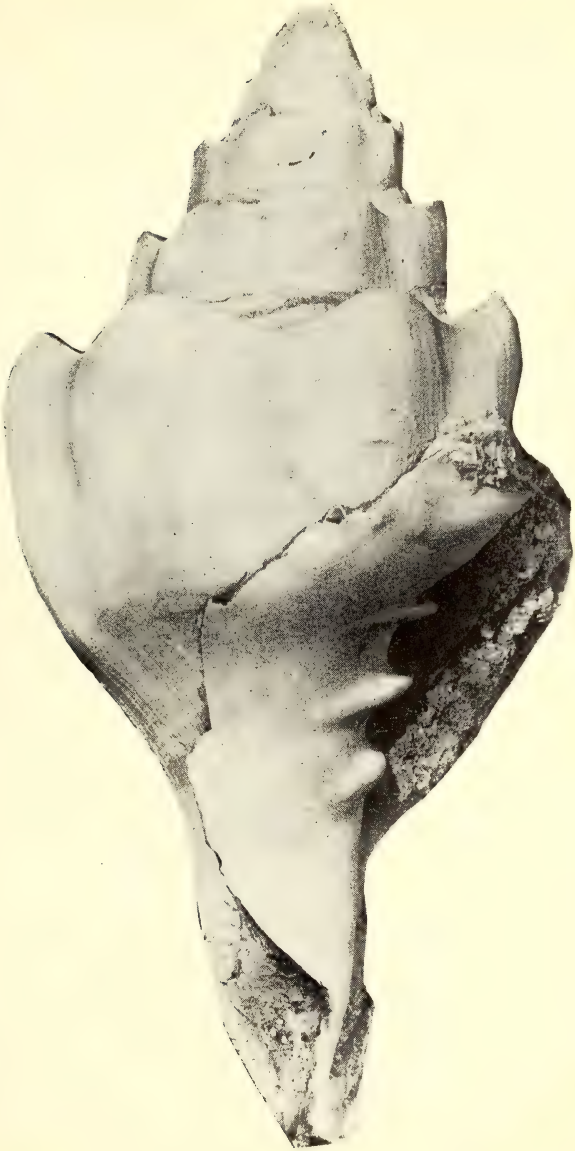

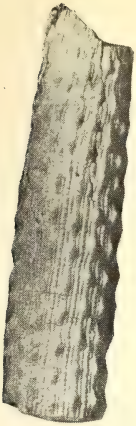
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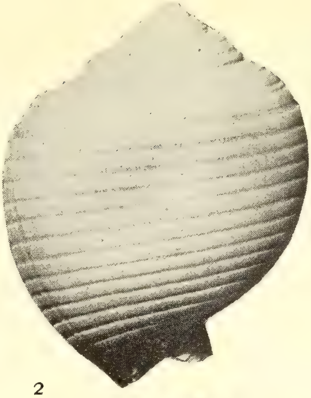
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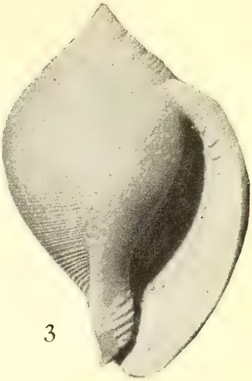
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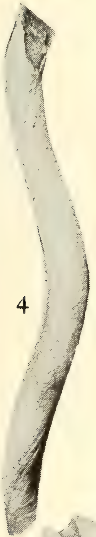
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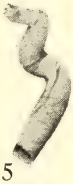
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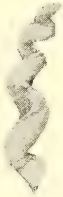
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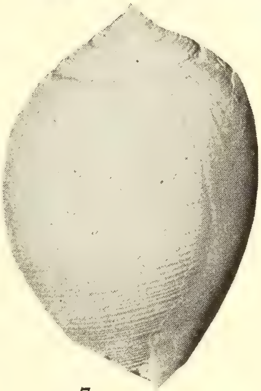
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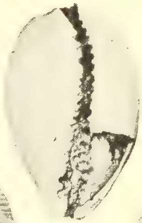
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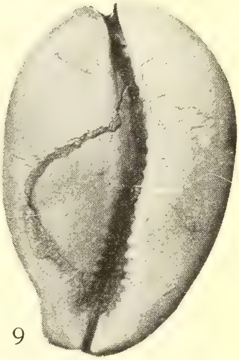
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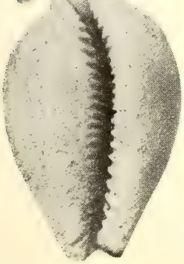
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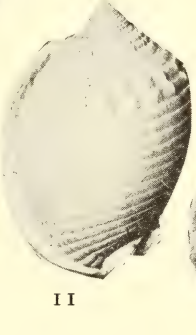
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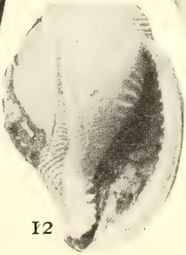
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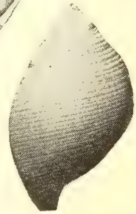
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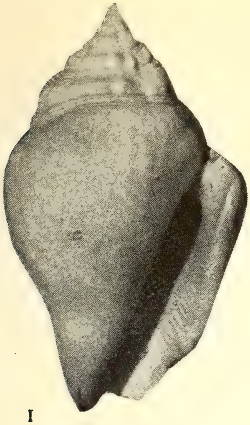
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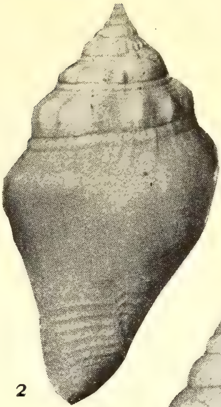
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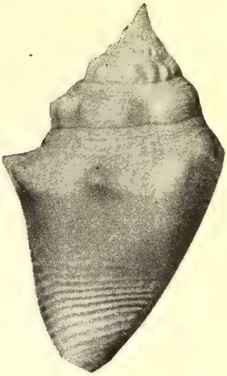
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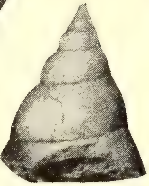
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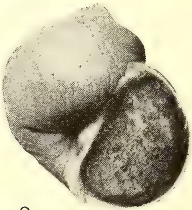
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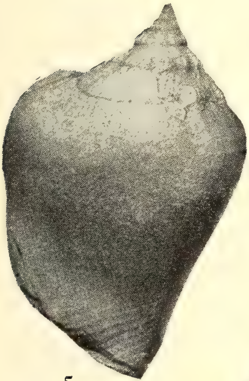
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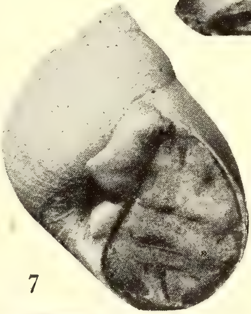
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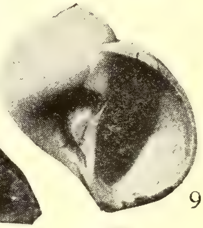
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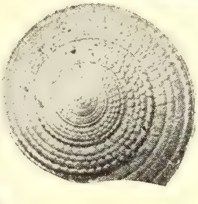
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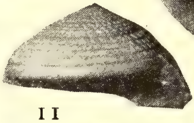
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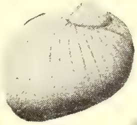
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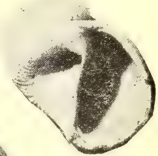
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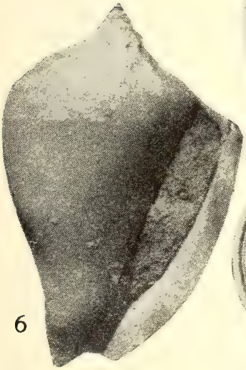
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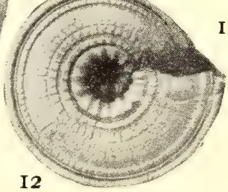
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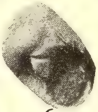
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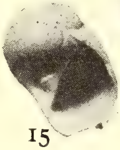
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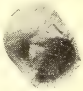
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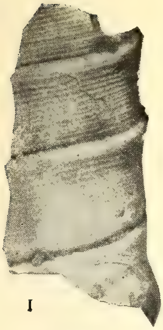

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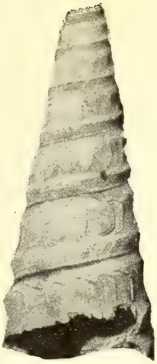

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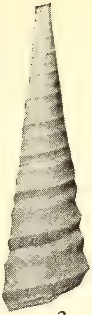

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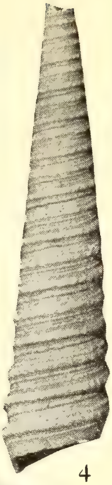

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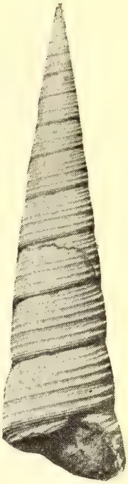

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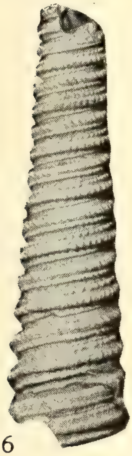

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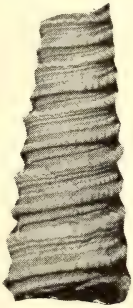

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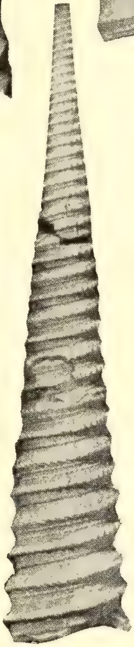

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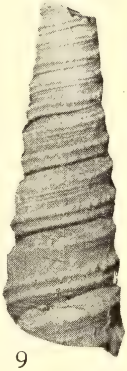

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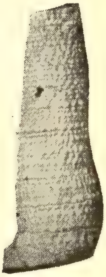

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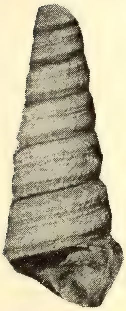

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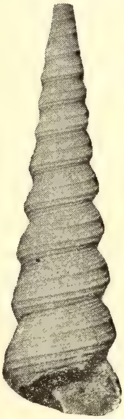

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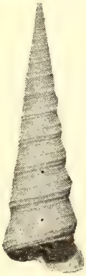

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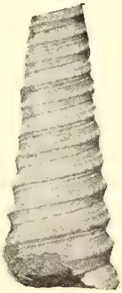

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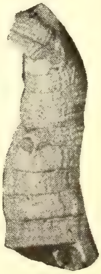

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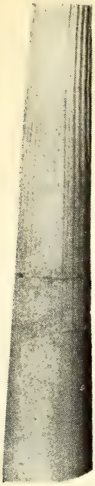
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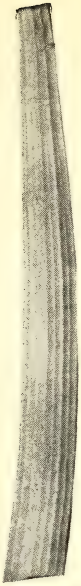
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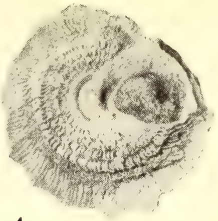
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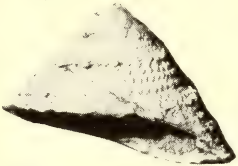
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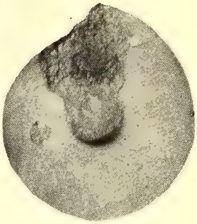
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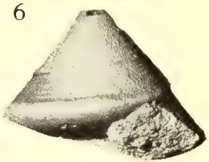
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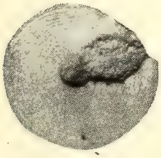
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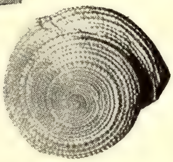
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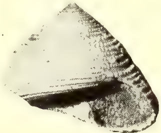
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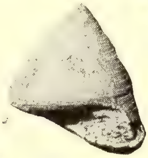
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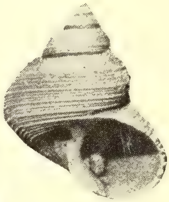
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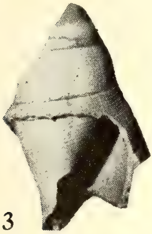
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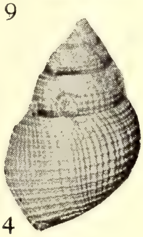
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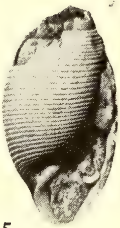
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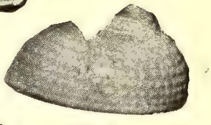
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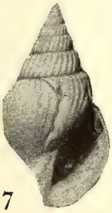
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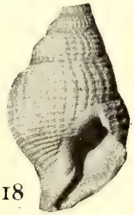
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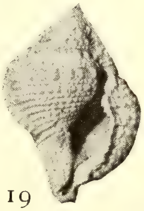
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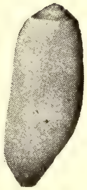
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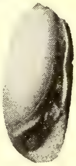
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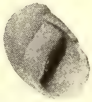
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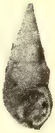
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BULLETINS
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Vol. 9

No. 39

The Miocene of Northern Costa Rica

WITH NOTES ON ITS GENERAL STRATIGRAPHIC RELATIONS

BY

A. A. OLSSON

Part 2
CLASS PELECYPODA

(*Pp. 169-Finis*)

June 21, 1922

Harris Co.
Cornell University, Ithaca, N. *Y.*
U. S. A.

ORDER PRIONODESMACEA

Genus **NUCULA** Lamarck

Nucula orbicella, n. sp. Plate 28, figures 19, 20

Shell of medium size, broadly elliptical or subovate in outlines; obliquely truncated at its anterior end; gently convex; the surface is covered with close, subregular, concentric wrinkles and fine radial threads so that the sculpture is decussated; on the posterior dorsal slope, they are larger and pustular-like and their course is obliquely downward across the growth-lines; they are weak on the poorly defined lunule; the radical threads are mainly between the concentric wrinkles but ventrally they cut into the wrinkles as well; interior of the shell, silvery white or faintly tinged with purple; the ventral margin is finely crenulated; chondrophore very small, oblique; anterior set containtng about 8 teeth, the posterior with about 17.

Length	height	semi-diameter
9.50,	7.50,	2.25 mm.
11.00	8.50	2.50 mm.

From the recent *N. crenulata* A. Adams, this shell differs by its larger size and more elliptical and depressed shell. Gabb has described from the Pliocene of the Limon Peninsula *Nucula limonensis* and *moenensis*, but both of these species are perfectly smooth and sculptureless. The *Nucula orbicella* is a common species in certain marly beds intercalated in the coralline limestones of Port Limon.

Gatun Stage: Port Limon.

Nucula cahuitensis, n. sp. Plate 18, figures 21-24

Shell small, solid, obliquely subtrigonal in form; ventral margin widely rounded, a nearly straight posterior dorsal margin and a widely truncated anterior end; valves gently convex; protoconch on the tip of the umbo small, smooth and white; surface polished; the sculpture of the disk of the shell is developed to a variable extent, but the umbos are always smooth; typically the lower half of the shell is covered with close, regular, concentric wrinkles which are slightly decussated by fine, even, and slightly raised radial threads; in other cases, the wrinkles may be present only on the extreme anterior or posterior ventral extremities and the radial lines showing only as a part of the shell substance and not as raised threads; the escutcheon is elliptical and thickly covered with raised wrinkles which lie at right angles to the dorsal margin of the shell; they are similiar on the lunule; interior of the shell tinted with brown; ventral margin crenulated; chondrophore small, oblique with the anterior set of teeth numbering about 7, the posterior about 14.

Length 3.50, height 3.00, diameter 1.60 mm.

This is a small species of subtrigonal outlines, suggestive of the Pacific *N. exigua* Sowerby in general form and size. On the few specimens of *N. exigua*, which I have from the Bay of Panama the sculpture is finely decussated over the whole shell with fine radial and concentric threads. The most striking features of *cahuitensis* are its strongly sculpture lunule and escutcheon.

Gatun Stage: Zone G, Saury Creek.

Nucula tenuisculpta Gabb Plate 18, figure 25

Nulua tenuisculpta Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 255.

Nucula tenuisculpta Maury, 1917, Bull. Amer. Pal., vol. 5, p. 325, pl. 26, figure 8.

A species of the size and form of *cahuitensis* but the valves are entirely smooth and polished. The lines of growth are fine and irregular. The radial lines are faint and sub-microscopic. Inner margin crenulated.

Height 3.25, length 4.00, semidiameter .75 mm.

Gatun Stage: Coll 4, Red Cliff Creek.

Genus **LEDA** Schumacher

Leda Balboae Prown and Pilsbry Plate 18, figure 15

Leda Balboæ Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 362, pl. 27, fig. 8.

This species is fairly common in Costa Rica, but generally smaller than in the Canal Zone, where it frequently reaches a length of 22 mm or more. Its valves are moderately convex and regularly sculptured with even, close, concentric riblets which on the center of the shell disk may be slightly appressed. The escutcheon is well-defined and similiarly sculptured with the riblets running parallel to the hinge margin.

Gatun Stage: Gatun, C. Z.
Coll. 1, East Grape Point Creek.
Zome G, Saury Creek.
Quitana Creek.
Hill No. 3, Banana River.

Leda Davilae, n. sp. Plate 18, figure 20

Shell small, solid, strongly convex; the beaks nearly central; the rostrum is short, pointed and sharply defined from the rest of the shell disk by a high, cord-like ridge; the anterior end is bluntly rounded and carries 2, low flexures from the beaks to the anterior ventral extremity; lunule small and narow, lacking the concentric ribs and sculptured with small, pustular-like ridges passing at right angles to the hinge-line; the sculpture consists of about 30 concentric riblets which are somewhat larger and with deeper interspaces on the umbos; the interspaces show on the umbos and along the anterior slope, fine, radial lines or punctations; interior of the shell cavity deep, with a heavy hinge; the anterior and posterior sets of teeth number about 13 or 14, are high and V-shaped.

Length 5.75, height 4.00, semi-diameter 1.75 mm.

A small, plump species, coarsely sculptured with even, concentric riblets, separated by deep interspaces. These interspaces may carry fine, radial lines or punctations at the base of the concentric ribs and are best seen on the umbones and the anterior slope. The *L. indigina* Dall (*L. bisulcata* Guppy) from the Miocene of Jamaica is similiar but proportionately longer.

Gatun Stage: Coll. 4, Red Cliff Creek.
Bocas Island.

Subgenus **ADRANA**, H. and A. Adams

Leda quitanensis, n. sp. Plate 18, figure 19

Shell thin, elongate but slightly convex; beaks very low and scarcely distinguishable from above and situated at the anterior 1-3; ventral margin an even curve from the pointed extremities; dorsal margin straight; surface polished but covered with very fine, concentric lines which are crossed on the lower half of the anterior 2-3, by even, oblique lines (*Scissula*-like); these oblique lines are spaced about .25 mm apart; interior concealed.

Height 7.25, lenght 26.00, semidiameter .75 mm.

A much smaller species than the next (*ensinoides*), slightly more convex and with beaks situated more anteriorly. The surface is finely sculptured about the middle and the anterior portion by slightly oblique lines, as seen on certain Tellinoids such as *Scissula*. The Manzanilla beds of Trinidad contain *Leda* (*Adrana*) *Guppyi* Dall (*Cercomya ledæformis* Guppy). It is less elongate, more contracted posteriorly and has a different surface sculpture. Dall has also recorded *Leda Guppyi* from the Bowden beds of Jamaica.

Gatun Stage: Quitana Creek.
Zone F, Saury Creek.
Coll. 1, East Grape Point Creek.

Leda ensinoides, n. sp. Plate 18, figure 12

Shell rather large, elongate, depressed and subequilateral;

beaks very small and scarcely distinguishable from above, and situated nearly about the middle of the dorsal margin; extremities bluntly rounded, with a broad, even curve to its base or ventral margin; the dorsal side is nearly straight but descending slightly towards its extremities; surface nearly smooth, the growth lines indistinct, but with fine, even very slightly oblique lines on the anterior two-thirds of the shell; interior concealed.

Length 54.00, height 15.00, diameter 4.50 mm.

Differs from the preceding species by its larger size, nearly central beaks and by its finer, more concentric sculpture. There are several species of this group recent in the West Indies and along the Pacific coast of Central America, but none appear at all closely related to the Gatun species.

Gatun Stage: Hill No. 3, Banana River.

Leda Dalliana, n. sp. Plate 28, figure 17

Adrana sp ? Dall, 1898, Trans. Wagner Free Inst. Sci., vol. 3, pt. 1 4, p. 592.

Shell small, thin, elongate, depressed; the small, scarcely differentiated beak is sutuated about the anterior one-fourth of the shell; the anterior side is somewhat contracted and shortly rounded while the posterior side is produced and 3 times the length of the anterior and bluntly pointed at its extremity; the rostrum is long and narrow, formed by 2 radial, scabrous threads, separated by a wide interspace; concentric sculpture of thin, elevated threads or lamellae, regularly distributed on the lower half of the shell, but widely spaced on the umbonal area; the escutcheon is long and narrow, sculptured with threads parallel to the hinge-margin; interior of shell cavity shallow, the long hinge with an anterior set of 20 small teeth, the posterior with 26 or 27.

Length 10.50, height 3.50, diameter of left valve .75 mm.

A much smaller species than the preceding and differing in its more anterior beaks, depressed shell and heavier concentric sculpture as well as in other characters. It is probably the shell which Dall refers to as having fragments of from the Pliocene of Limon. But a single perfect specimen was collected

Gatun Stage; Port Limon.

Genus **YOLDIA** Moller

Yoldia bocasensis, Plate 28, figures 21, 22

Shell small, thin, ovate-elliptical in form; beaks situated slightly in front of the middle; valves moderately convex; both the anterior and posterior extremities are broadly rounded and connected by the gentle curve of the basal or ventral margin; the umbos are very small but distinct and lie just above the greatest convexity of the valves; surface smooth, polished with no other sculpture than the incremental growth-lines; chondrophore distinct, scarsely oblique and bordered on each side by an equal number of V-shaped hinge-teeth; the anterior set contains about 14 teeth, which are very small next to the chondrophore becoming progressively larger distally, the posterior set with 13 or 14; the pallial sinus is indistinct, but rather large, broad and extends nearly to the middle of the valve.

Length	height	semidiameter
13.00,	7.00,	2.25 mm.
9.50	5.50	1.50 mm.

A fairly common species in the clay beds of Bocas Island where it is associated with a fauna of rather deep water character. It has much the form of certain deep-water *Yoldiella* but the interior of the valves show an indistinct but deep and wide pallial sinus.

Gabb has described from the Miocene of Santo Domingo, a *Yoldia ovalis*, which has never been figured and its description is very meager and insufficient.

Gatun Stage: Bocas del Toro.

Genus **LIMOPSIS** Sassi

Limopsis monilis, n. sp. Plate 26, figures 23, 24

Shell small, solid, moderately convex and subcircular in form but slightly oblique; the hinge-line is straight, the anterior dorsal submargin very small, the posterior large undifferentiated from the rest of the shell ; the umbos are high and prominent, lying a little in front of the middle; exterior sculptured with strong radial ribs which are largest and strongest on the middle of the shell disk, finer on the dorsal submargins; these ribs are crossed by high widely spaced concentric lamellae, more closely spaced on the umbos; the lamellæ on crossing the ribs are raised into short, spine-like fringes which are directed ventrally; interior of shell deep; the hinge-line with a small cartilage pit at the anterior 1-3 of the shell; it is bordered on the anterior side by a set of 3 high, projecting teeth and 4 on the posterior side, the ventral and a part of the anterior margin is crenulated, most finely in the middle and quite coarsely at the posterior portion.

Length 1.75, height 2.00, semidiameter .60 mm.

This is a small, subcircular species with a crenulated inner margin and a strong surface sculpture of ribs crossed by distant concentric fringes. It is fairly common at its type locality, given below.

Gatun Stage: Old Man Sam Creek, 1 mile south of beach (A. C. Veatch, collector).

Genus **GLYCYMERIS,** Da Costa

Glycymeris canalis Brown and Pilsbry Plate 18, figures 2-7

Glycymeris canalis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 364, pl. 28, fig. 10.

Glycymeris trilobicostata Pilsbry and Brown, 1917, Proc. Acad, Nat. Sci. Phila.

Very abundant locally in the Gatun beds of Costa Rica, are small and medium sized Pectunculids belonging to the group of

G. acuticostata Sowerby of the Santo Dominican Miocene. They vary somewhat in size, (20 to 32 mm in height), are usually depressed and with an outline suggestive of the recent East Coast and Upper Miocene *G. pectinata* Gmelin. Typical *acuticostata* does not seem to occur in Costa Rica and I have adopted Brown and Pilsbry name of *canalis*.

The *G. canalis* Brown and Pilsbry from the Canal Zone, and the *trilobicostata* Pilsbry and Brown from Colombia, are both based on young shells 15 mm or less in height. Both forms can be duplicated amongst the Costa Rican shells and are but varieties of the same species.

In its usual and more abundant form, the shell is depressed, with numerous (about 26), closely spaced rounded or angled ribs. These ribs are overrun by even, close, concentric threads. They represent the usual *canalis* or its variety *trilobicostata*, and average in height about 25 mm. More rarely, the shells are larger and as illustrated by figure 4 and 5 the ribs may become divided into 2 or 3, strong, radial cords. The following measurements will show the usual range in size.

Height	diameter	thickness
22,	21,	5.5
24	23	5.5
32	32	8
29	29	8

Gatun Stage: Gatun, C. Z.
Comadre; Banana River; Coll. 4 East Grape Point Creek.
Old Man Sam Creek, C. R.

Glycymeris jamaicensis Dall Plate 19, figures 3, 4

Pectunculus pennaceus Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p, 293. Not of Lamarck.

Axinea pennacea Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 255.

Pectunculus decussatus Guppy, 1876, Qart. Journ. Geol, Soc. London, vol. 32, p. 532. Not of Linné.

Glycymeris jamaicensis Dall, 1898, Trans. Wagner Free Inst., Sci., vol. 3, pt. 4, p. 608.

Glycymeris jamaicensis Maury, 1917, Bull. Amer. Pal., vol. 5, p. 345, pl. 26, fig. 13.

This large Pectunculid, externally resembles in its angular posterior side the *Glycymeris pennacea* with which it was confused by Guppy and by Gabb. It differs in being somewhat less convex, less strongly sculptured and most importantly in its central beaks, located about the middle of the ligamental area. It is, on the other hand, much more closely allied with the recent West Indian *G. undatus* Linné (*G. lineatus* Reeves) of which it is doubteless the Miocene ancestral form, the main difference being in details of its finer sculpture.

The *Glycymeris jamaicensis* occurs in the Miocene of Jamaica and Santo Domingo but there never seems to reach the large size that the species sometimes attains in Costa Rican. A large shell in our collection from Old Man Sam Creek measures as follows:

Height 60, lenght 60, diameter of both valves 37 mm.

Gatun Stage: Water Cay.
Coll. 5, Red Cliff Creek.
Coll. 4a, East Grape Point Creek.
Colls. 5, 6, Old Man Sam Creek.
Sousi Creek of Upper Hone Creek.

Glycymeris carbasina Brown and Pilsbry Plate 19, figures 1, 2, 5

Glycymeris carbasina Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 363, pl. 28, fig. 9.

The *Glycymeris carbasina* was described by Brown and Pilsbry from a small individual from Gatun, measuring only 16 mm in height. It is closely related to the *G. jamaicensis* Dall and probably represents but a varietal form. Its main differences is its more circular and less convex shell, and less number of hinge-teeth which number about 10 to 12 on the anterior and posterior sides respectively.

All our specimens were collected in the lower Gatun of E. Grape Pt., Cliff Creek in Eastern Costa Rica, the largest shell measuring as follows:

Height 56, length 55, diameter of both valves 32 mm.

Gatun Stage: Coll. 4, East Grape Point.

Glycymeris castaneus Lamarck Plate 18, figures 13, 14

Pectunculus castaneus Lamarck, 1819, Anim. sans Vert., vol. 6, p 53.

Pectunculus castaneus Reeve, 1843, Conch. Icon., *Pectunculus* pl. 6, fig. 32.

Our collection from the Banana River contains several small Pectunculids which differ from the *jamaicensis* and its allies by their less circular shell, greater convexity and coarser radial sculpture. These shells agree however very closely with a recent species which is abundant on the beaches of northern Costa Rica, which appears to be the *Glycymeris castaneus* of Lamarck. *Glycymeris castaneus* is distinct from *undutus* Linné (*G. lineatus* Reeve) with which it is sometimes united, differing by its form which is more produced posteriorly but not angulated and by its more pronounced radial costæ. Both species are similiarly colored with chestnut markings.

Gatun Stage: Hill No. 3, Banana River.
Quitana creek.

Glycymeris decussatus Linnæus Plate 19, figures 6, 7

Arca decussatus Linnæus, 1758, Syst. Nat., ed. 10, p. 694.

Pectunculus pennacea Lamarck, 1819, An. s. Vert., vol. 6, p. 51.

Pectunculus pennacea Reeve, 1843, Conch. Icon., *Pectunculus*, pl. 5, fig. 24.

Pectunculus decussatus Linné. *P. pennaceus* Lamarck, (Lamy) 1911, Journ. de Conchy., vol. 59, p. 119, pl. 3, fig. 7.

Of this rare shell, more commonly known as the *G. pennacea* Lamarck we have several excellent specimens collected by

Dr. A. C. Veatch from the Upper Gatun of Old Man Sam Creek in eastern Costa Rica and a few specimens from the coral-reef limestones of Port Limon. Although a very distinct species and not to be confused with any other Pectunculid recent or fossil, its characters have been generally misunderstood and its name has often been applied to shells of the *G. lineatus* group.

The shell is of moderate size, strongly convex and inequilateral. The beaks are slightly posterior of the middle, with the ligamental area entirely anterior to the beaks as seen in figure 7. The surface is sculptured with numerous, moderately coarse, radiating threads which are simple on the umbonal area but become divided by 3 or more finer threads ventrally.

Gatun Stage: Old Man Sam creek.
Port Limon.

Glycymeris Lloydsmithi Pilsbry and Brown Plate 25, figures 8. 9, 10

Glycymeris Lloydsmithi Pilsbry and Brown, 1917, Proc. Acad. Nat. Sci. Phila., vol. 59, p. 39, pl. 6, fig. 6.

This is an abundant fossil in eastern Costa Rica, where it frequently forms zones in the lower and middle Gatun. Its type of sculpture of broad, smooth, rounded ribs, is strikingly like that of *G. subovata* Say of the Miocene of eastern United States. It differs in its higher and narrower umbos and by its nearly smooth cardinal area.

The *G.Lloydsmithi* was described by Pilsbry and Brown, from beds equivalent to the Gatun, near Cartagina, Colombia.

Gatun Stage: Zone 3, East Grape Point Creek, C. R.
Coll. 5, Red Cliff Creek, C. R.
Headwater of Middle Creek, C. R.

Genus **ARCA** Linnæus

Arca occidentalis Philippi Plate 22, figure 1

Arca occidentalis Philippi, 1847, Abbild. u. Beschr., 3, p. 14, pl. 17b, fig. 4a-c.

Arca noæ Guppy, Journ. Geol Soc. London., vol. 22, p. 293.

Arca occidentalis Sheldon, 1916, Paleont. Amer., vol. 1, p. 8, pl. 1, figs. 8-11.

Arca occidentalis Maury, 1917, Bull. Amer. Pal. vol. 5, p.327, pl. 29, fig. 3.

This is a common recent species of the West Indian and Caribbean fauna. As a Miocene fossil it is found in Jamaica and Santo Domingo and it is here recorded from the Miocene of Costa Rica.

Gatun Stage: Port Limon.

Arca umbonata Lamarck Plate 22, figure 2

Arca umbonata Lamarck, 1819, An. s. Vert., vol. 6, p. 37.

Arca imbricata Gabb, 1873, Trans. Amer. Phila. Soc., vol. 15, p. 254, In part.

Arca umbonata Sheldon, 1916, Palæont. Amer., vol. 1, p. 8. pl. 1, figs. 12-17.

Arca umbonata Maury, 1917, Bull. Amer. Pal., vol. 5, p. 327, pl. 30, fig. 11.

Arca mubonata Maury, 1920, New York Academy of Science, Sci. Sur. of P. R., vol. 3, pt. 1, p. 6.

The *Arca umbonata* and the preceding *occidentalis* area common as recent shells along the entire northern coast of Panama and Costa Rica. The *A. umbonata* is recognized by its more convex and angular shell and finer sculpture of the middle of the shell disk. As a Gatun fossil we have but a single small shell from the East Grape Point Creek. Dr. Maury records the species from the Miocene of Santo Domingo and from Porto Rico.

Gatun Stage: Coll. 1, East Grape Point Creek.

Subgenus **BARBATIA** (Gray) Adams

Arca Mauryae, n. sp. Plate 22, figure 4, 7

Barbatia cf. *Bonaczyi* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 329, pl. 30, fig. 15. Not of Gabb.

Shell small, thin, convex, subrhomboidal in form; umbos wide and full; with the beaks at the anterior 1-3 of the shell; a rounded posterior umbonal slope; the anterior extremity is broken in the type specimen but from the earlier growth lines is simply rounded in form; the posterior side is obliquely truncate and meets the dorsal margin in a well-marked angle; the exterior is sculptured like that of *Arca barbata*, with the riblets grouped in wide, regular bands which are defined by slightly deeper interspaces; the radial riblets are crossed and crudely granulated by concentric threads; the sculpture on the posterior submargins is much heavier and predominantly radial that of the anterior submargin is but slightly heavier than on the middle of the shell disk; interior of shell cavity deep, with a straight hinge-margin, the teeth arranged as in *barbata*; cardinal area rather high, longitudinally striated posterior of the beaks, plain in front.

Length 24? height 11.50, semidiameter 5.50 mm.

This species is closely related to the recent *Arca barbata* Linné. It differs from *barbata* in its proportional shorter shell, greater convexity, less anterior beak and higher cardinal area. It is equivalent to the Dominican shell figured by Dr. Maury as *Barbatia* cf. *Bonaczyi* Gabb. Gabb in his remarks following his his description of *Bonaczyi*, compares his shell with *barbata*, and states that in *Bonaczyi*, the beaks are more anterior and the posterior end more produced and sloping. This is the reverse of the conditions as seen in the present shell. Dall on the other hand, considers Gabb's shell as synonymous with *Arca umbonta* Lamarck.

Gatun Stage: Port Limon.

Section **CALLOARCA** Gray

Arca cf. candida Gmelin Plate 22. figures 5, 6

Arca candida Gmelin, 1792, Syst. Nat., p. 3311.

Barbatia (*Calloarca*) *candida* Dall, 1898, Trans. Wagner Free Inst., Sci., vol. 3, pt. 4, p. 626.

Arca cadida Shelton, 1916, Palaeont. Amer., No. 1, p. 16, pl. 3, figs. 11, 12.

We have several small valves of a *Calloarca* from the Miocene limestones of Port Limon, the largest of which has a length of 18 mm. They belong to the *Arca candida* group and may possibly represent the young of that species. They seem to differ in being more finely sculptured, especially about the middle of the shell disk. This sculpture consists of fine, beaded or granulated radial threads, which become coarser on the anterior and posterior submargins.

The *Arca candida* is recorded by Dall from the Bowden beds of Jamaica, the equivalent of the coral limestones of Limon. Dall also mentions from the same locality, the occurrence of a smaller and possible distinct species. The *Arca candida* is a common recent species of the West Indies and the Caribbean, and is abundant on the north coast of Panama and Costa Rica.

Length 18, height 11?, semidiameter 3.75 mm.

Gatun Stage: Port Limon.

Subgenus **SCAPHARCA** Gray

Arca dariensis Brown and Pilsbry Plate 22, figures 10-13

Arca oronlensis Dall, 1898, Trans. Wagner Free Inst. Sci., vol., 3, pt. 4, p. 658. Not of Gabb.

Arca dariensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 362, pl. 22, fig. 10.

Arca gatunensis Toula, Dec. 1911, Jahrb. der K-K Geol. Reichsanstalt, vol. 61, p. 493, pl. 30, fig. 4.

The common Ark of the Canal Zone. The shell is elongate in form with about 30 ribs. The ribs of the left valve are usually granulated over the whole shell, while those of the right valve are narrow and smooth on the middle of the shell disk. The ribs are characteristically divided on the anterior and posterior ends of the shell.

Gabb has described an *Arca oronlensis* from the black shales of Oronli Creek in the Talamanca Valley (probably the Uscari shell). It is like *A. dariensis*, in form, but with more central beaks and umbones and simple ribs. We have not seen this species.

Gatun Stage: Gatun and Mt. Hope, C. Z.
Water Cay.

Arca actinophora Dall Plate 23, figs. 7, 8; Plate 25, fig. 3

Scapharca (*Scapharca*) *acitnophora* Dall, 1898, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4 p. 647, pl. 33, fig. 26.

Scapharca (*Scapharca*) *actinophora* Sheldon, 1916, Paleont. Amer., vol. 1, p. 50, pl. 11, fig. 13.

A larger species than the *dariensis*, with broad, wide umbos. The ribs number 36 to 40, are narrow and separated by interspaces of a little more than their own width. These interspaces are generally finely ornamented by regular, even, concentric threads. The ribs are simple and on the left valve, usually strongly beaded or granulated throughout, becoming wider and smoother on the posterior portion, or with the granulations only on their edges, so that the ribs appear as if mesially depressed. The ribs of the right valve are less strongly beaded and may become quite smooth, especially on the center of the shell disk.

Its ventral margin is gently curved to the rounded and not pointed posterior extremity.

It is a common species at Mt. Hope in the Canal Zone, but it also occurs but less abundant in Western Panama and in Costa Rica.

Gatun Stage: Mt. Hope, C. Z.
Water Cay, Panama.
Zone 4, Red Cliff Creek, C. R.
Coll. 3, Hone Walk Creek, C. R.
Hill 1 Banana River, C. R.

Arca Henekeni Maury Plate 24, figs 13, 14

Arca consobrina Sowerby, 1849, Quart. Journ. Geol. Soc. London, vol. 6, p. 52, pl. 10, fig. 12. Not of d'Orbigny, 1844.

Arca consobrina Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 32, p. 531.

Arca consobrina Dall, 1888, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 646.

Arca consobrina Sheldon, 1916, Paleont. Amer., No. 1, p. 49.

Arca Henekeni Maury, 1917, Bull. Amer. Pal., vol. 5, p. 331, pl. 29, fig. 2.

Arca (*Scapharca*) *sobrina* Pilsbry and Johnson, 1917, Proc, Acad. Nat. Sci. Phil., vol. 64, p. 186.

Our shells from Water Cay are similiar in form and general sculpture to the *A. Henekeni* Maury (*A. consobrina* Sowerby), from the Miocene of Santo Domingo, the only noticeable difference being the greater number of ribs on the Panama shell. The ribs of *Henekeni* from Water Cay average about 39 in number, and 35 to 36 on the Dominican shells. The ribs of the left valve are evenly beaded or granulated by concentric threads which pass across the interspaces as elevated threads. The ribs of the posterior-dorsal submargins are nearly smooth. They are more or less divided at the anterior extremity and very finely beaded.

Length 29, height 18.25, diameter 14.15 mm.
31, 18, semidiameter of right value 7.25 mm.

Gatun Stage: Water Cay.

Arca costaricensis, n. sp. Plate 25, figures 1, 2

Shell moderately large, elongate, convex, with the beaks situated at the anterior 1-3;ventral margin but gently curved to the attenuated and pointed posterior extremity; right valve with about 30 ribs, of which the most anterior and posterior ones are rather wide, the others narrow; interspaces on the center or the disk 3 times or more the width of the ribs; the ribs of the right valve are obscurely granulated on the anterior extremity, more or less smooth on the center but on the posterior extremity, they are double and peculiarly granulated along their sides;

this granulation begins on the sides and on the more anterior ribs, the center is smooth; this granulation is in the form of inverted V's; their acute apices lying along the center of the ribs; the ribs of the left valve are more or less granulated or beaded throughout and with the ribs on the posterior extremity, double and similiar to those of the right valve; hinge-line straight, with very numerous small, uninterrupted teeth; a rather wide cardinal area with 5 or 6 ligamental grooves; ventral margin internally fluted in harmony with the external ribs.

Length	height	diameter	
52,	28,	34 mm.	
52,	32,	17 mm	(right valve).

The form of this shell with its gently curved ventral margin and attenuated posterior extremity is like the *Arca actinophora* Dall, but is longer and with fewer and heavier ribs. On the other hand, this species may be compared with *dariensis* Brown and Pilsbry, from which it differs most strikingly by its larger size, wider, higher and more central umbos and more pointed attenuated posterior extremity.

Gatun Stage: Hill 1a, Banana River.
Hill 2, Banana River.
Zone 7, Pumbri Creek.

Arca honensis, n. sp. Plate 22, figures 8, 9

Shell rectangular, elongote, moderately convex; beaks situated at about the anterior 1-4; right valve with about 26, narrow, smooth or irregularly granulated ribs, separated by interspaces of twice their own width; the left valve with the same number of ribs and similiar to those of the right valve; the ribs of both valves are simple and undivided and if granulated, most heavily on the anterior half of the left valve; interspaces smooth or with irregular, raised concentric threads; cardinal area long and rather wide and with 5 or 6 linear grooves; hinge-lines straight with very numerous, small, uninterrupted teeth; ventral margin fluted in harmony with the external ribs.

Length	height	semi-diameter	
39,	23.5,	11 mm	(lest valve)
36.5	23	12	(left valve)
34	23	11	(right valve)

In general form, quite similiar to the *Arca dariensis* Brown and Pilsbry, but distinguished mainly by its simple, undivided ribs. It is also a more convex shell, with higher and more prominent umbos. It differs from Gabb's figure of *A. oronlensis* in its more anterior umbos.

It is a common species, occurring in zones in the Gatun sandstone of Hone Walk Creek of Eastern Costa Rica.

Gatun Stage: Hone Walk Creek.

Arca golfoyaquensis Maury, var. **medioamericana,** n. var.
Plate 23, figures 4-6

cf. *Arca golfoyaquensis* Maury, 1917, Amer. Pal., vol. 5, p. 332, pl. 28, fig. 5.

? *Arca* (*Andara*) *consobrina* Gabb, 1881, Journ. Acad. Nat. Sci. Phila., 2nd series, vol. 8, p. 378.

The *Arca golfoyaquensis* was described by Dr. Maury from the Gurabo and Cercado formation of Santo Domingo. It is closely related to the *Arca Henekeni* Maury, (the *Arca consobrina*) differing mainly in form.

The Costa Rican shells are very similiar to Dr. Maury's type specimens of *golfoyaquensis*, but differ in having 35 instead of 38 ribs, a higher shell, fuller umbos and sharper ribs on the posterior-dorsal area. The central ribs of the left valve are elegantly beaded with their interspaces evenly sculptured with raised concentric threads. On the right valve, the ribs are more smooth but their interspaces are similiarly sculptured to those of the left. The ribs of the posterior-dorsal angle of both valves become divided ventrally by 2 or 3 fine threads. The posterior extremity is straight, meeting the hinge-line at an angle of nearly 120 degrees.

Length 54, height 34, diameter 34 mm.

Gatun Stage: Hill 1, Banana River.
Coll. 5, Red Cliff Creek.
Rio Blanco.
Old Man Sam Creek, 1 mile south of beach.

Arca Veatchi, n. sp. Plate 23, figures 1-3

Shell large, moderately convex; in outline, the shell is nearly square with the height about equal to its length; the anterior side is widely rounded to the ventral margin, the posterior side nearly straight, nearly at right angles to the hinge-line; umbos wide, with the unbonal angle widely rounded and with the extreme tip of the beaks situated at the anterior 1-3 of the total length of the shell; right valve with about 45 ribs, of which the posterior 14 are on the posterior-dorsal slope; the ribs are rectangular in section with the interspaces on the center of the disk about 3-4 of the width of the ribs; the ribs are finely sculptured but less strongly on the right valve; on the center of the shell disk, the ribs are finely nodulated or granulated but on the posterior-dorsal slope and on the anterior extremity, the granulations of the ribs is gradually overshadowed by the introduction of 4 or 5 fine, threads on the top of each rib the interspaces on the center of the disk of the left valve are finely sculptured with even, raised concentric threads; the left valve is slightly larger and overlaps to a small extent the right; hinge-line straight with numerous small teeth, larger and higher at the extremities; cardinal area that of typical *Scapharca*, and grooved with 3 lines; interior of the shell deep, with the posterior adductor scar about twice the size of the anterior; basal margin fluted in harmony with the external sculpture.

Length 51, height 51, diameter 41.5 mm.

This is a rather large, *Cardium*-like *Arca* of nearly square outlines and numerous finely sculptured ribs. Its form is also suggestive of *Argina*, but its cardinal area is that of a true *Scapharca*. The type specimen, a finely preserved individual with both valves comes from the Gatun of Water Cay. It is quite unlike any other known American species.

It is named for Dr. A. C. Veatch, Director of the Exploration Department of the Sinclair Consolidated Oil Corporation.

Gatun Stage: Water Cay.
Mt. Hope, C. Z.

Arca auriculata Lamarck Plate 22, figure 3

Arca auriculata Lamarck, 1819, n. s. Vert., vol. 6, p. 43.

Arca (*Scapharca*) *auriculata* Dall, 1898, Trans. Wagner Free Inst., Sci., vol. 3, pt. 4, p. 649.

Arca auriculata, Sheldon, 1916, Paleont, Amer., vol. 1, p. 50, pl. 11. fig. 19,

Scapharca auriculata Maury, 1917, Bull. Amer. Pal., vol. 5, p. 339, pl. 28, fig. 3.

A common, recent species of the West Indies. Its hinge-line is generally produced or auriculated at its posterior extremity.

It occurs in the Miocene of Jamaica and Santo Domingo. Dall also records it from near Limon.

The Costa Rican specimens in our collection are all small but otherwise typical.

Gatun Stage: Coll. 3, Hone Walk Creek.
Old Man Sam Creek, 1 mile south of the beach.

Section **CUNEARCA** Dall

Arca cacica, n. sp. Plate 24, figure 1

Shell of moderate size, strongly convex and with high, inflated umbos; beaks and umbos about the middle of the shell; the greatest convexity of the shell lying about the anterior 1-3, and with a narrow but deep, radial depressed zone extending from the beaks to the ventral margin, just anterior to the umbonal angle; the anterior end is slightly rounded, the posterior submargins strongly depressed or flattened with a straight posterior margin; the left valve with 30 smooth and strongly nodulous radial ribs of which 9 are situated on the posterior submargin; the ribs of the posterior submargin are low, wide and nearly smooth; on the rest of the shell, the ribs are nodulose, very regularly in the middle of the valves more distantly on the anterior ribs; the interspaces between the ribs are narrow on the middle of the valves, become wider anteriorly and on the extreme anterior extremity equal the ribs in width; the cardinal area is high, as nearly ½ of the length.

Length 39, height 33, diameter of the left valve 15 mm.

The above description is based on a single left valve from the Upper Gatun beds near Cahuita. Distantly related to the *Arca incongrua* Say and its southern form *brasiliana* Lamarck, the fossil species differs in its higher and more convex shell, and in its high cardinal area. In this latter feature, this species is like the recent West Coast *Arca labiata* Sowerby, but has a greater number of ribs and different form.

Gatun Stage: Across the divide from Comadre Creek.

Groups of *Arca Pittieri* Dall

This is a group of small and medium-sized Arks, containing 3 species, whose general appearance is that of the recent *Arca Chemnitzi* Phil. The Costa Rican shells are usually abundant wherever they occur in the Gatun formation. Their relations and differences may be summarized as follows:

A. Both valves more or less similiarly sculptured, that is the ribs of the posterior half of the right valve, at least obsoletely beaded.

B. Ribs 25 to 28; umbos high and full; posterior-dorsal slope, angular; posterior extremity somewhat produced, giving an elongate outline to the shell.

Area Pittieri Dall

AA. Valves not similiarly sculptured; posterior half of the right valve with narrow ribs, separated by wide interspaces.

B. The intervals between the ribs on the posterior half of the right valve with small (sometimes faint) interstitial threads. Ribs about 29.

Arca Lloydi, n. sp.

BB. The intervals between the ribs on the posterior half of the right valve smooth; ribs 25, shell usually larger.

Arca Hindsi, n. sp.

Arca Pittieri Dall Plate 24, figures 2-6

Arca (*Scapharca*) *Pittieri* Dall 1912, Smith. Misc. Coll., vol. 59, No. 2, p. 9.

This is a common species in the Gatun beds of the Banana River. The ribs of the 2 valves are similarly sculptured but somewhat less strongly on the right. The umbos are high. The posterior extremity is pointed and produced so that the outline of the shell is more elongate than in the following species:

Length 25, height 25, diameter 26 mm.
29 28 semi-diameter 14.5 mm.

Gatun Stage: Hill 1a, Banana River, 3.
Zone E, Saury Creek.
Rio Betey.
Coll. 7, Pumbri Creek.

Arca Lloydi, n. sp, Plate 24, figures 10-12

Shell small, cordiform, covex, subrectangular in outline but with the left valve somewhat more pointed at its posterior-ventral extremity; anterior side well rounded; posterior side straight and meeting the basal margin at an angle of about 75 degrees; umbonal angle rounded; the left valve has 29 ribs of which 9 are found on the posterior- dorsal slope; the ribs of the left valve are strongly beaded or granulated, and separated by interspaces of about their own width; on the right valve, the first 10 anterior ribs are strongly beaded; the next set as far as the umbonal angle are smooth, beyond which on the posterior-dorsal slope the ribs again become beaded as they approach the dorsal margin; the interspaces on the right valve are wide, and on the shell disk anterior to the umbonal angle they carry a fine, but often faint interstitial thread; the intervals are otherwise smooth or finely etched with concentric lines; hinge-lines straight with numerous small, vertical teeth and a wide, smooth cardinal area.

Length 18, height 18, semi-diameter 9.5 mm.

A smaller species than the following (*Hindsi*) and easily distinguished by the interstitial thread of its right valve. It is much less common than the other two species.

Named for Dr. E. R. Lloyd, formerly of the United States Geological Survey, and who was a member of the first Exploration Party of the Sinclair Oil Company in Panama and Costa Rica.

Gatun Stage: Hill 3, Banana River.
Zone 5, Red Cliff Creek.
Coll. 7, Pumbri Creek.

Arca Hindsi, n. sp. Plate 24, figures 7-9

Shell small or of medium size, cordiform and similiar in outline to the preceding species but larger; umbos high and wide, and but slightly anterior to the middle; the left valve has about 26 strongly nodulated ribs, separated by interspaces of slightly greater width; the first 9 or 10 ribs of the right valve are nodulated, followed by smooth ones to the umbonal angle, beyond which the remaining 7 become nodulated as they approach the dorsal margin; interspaces wider than the ribs, smooth and without any interstitial thread; hinge-line straight with numerous, small vertical teeth and a wide, smooth cardinal area; on some shells the ligamental area may carry one or two, small diamond-shaped grooves.

Length 24, height 25, semi-diameter 14 mm.

A much larger species than the *Lloydi* and without any interstitial thread in the interspaces of its right valve. It is named for Dr. Henry Hinds, formerly of the United States Geological Survey and the Exploration Department of the Sinclair Consolidated Oil Corporation.

Gatun Stage: Hill No. 3, Banana River.
Zone E, Saury Creek.
Coll. 1, East Grape Point Creek.
Coll. 3, East Grape Point Creek.
Rio Betey.

Subgenus **NOETIA,** Gray

Arca MacDonaldi Dall Plate 25, figures 4-7

Area (Noetia) MacDonaldi Dall, 1912, Smith, Misc. Coll., vol. 59, No. 2, p. 9.

This large *Noëtia,* is very common and characteristic of the Gatun formation in many parts of Northern Costa Rica, and large specimens may reach a length and height of 55 mm or more. It was originally described by Dall from specimens collected by Pittier and MacDonald from the Gatun beds of the Banana River, where it is associated with *Arca Pittieri* and is very abundant.

Two forms or varieties may be recognized. In typical *MacDonaldi*, the shell is high, trigonal, with *elevated*, *narrow umbos* and a *producted anterior extremity*. The beaks are separated from the hinge-line by a *wide ligamental area*. This is the common form along the Banana River. Frequently associated with typical *MacDonaldi* are shells with a more *rectangular outline*, *lower* but *wide* umbos. The beaks are close to the hinge line so that the *ligmental area is narrow*. These two types have a very different appearance but seem to be connected by transitional forms. To the last variety, I propose the name of *subreversa*.

Among recent shells, the *Arca MacDonaldi* finds its closest relation with the common *Arca reversa* Sowerby of the Pacific coast of Central America.

Gatun Stage: Hill 1, 1a, Banana River, typical and var. suberversa
Coll. 7, Pumbric Creek (typical)
Coll. 6, Red Cliff Creek (typical)
Betey (subreversa)
Zone G, Saury (subreversa)

Genus **PTERIA,** Scopoli

Pteria inornata Gabb Plate 28, figure 9

Avicula inornata Gabb, 1873, Trans. Amer. Phil. Soc., vol., 15, p. 253.

Pteria inornata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 669.

Pteria inornata Maury, 1817, Bull. Amer. Pal., vol. 5, p. 345, pl. 26, fig. 14.

This species is locally common in Costa Rica, but generally difficult to collect because of its thin and fragile shell. Its valves are as high as long, strongly convex and smooth. The anterior ear is of medium size, the posterior much larger and produced.

It was described as a Miocene fossil from Santo Domingo, but has also been collected at Bowden.

Uscari formation. Old Harbor.
Gatun Stage: Zone 3; Red Cliff Creek.

Genus **OSTREA,** Linnæus

Ostrea megodon Hanley Plate 18, figure 1

Ostrea megodon Hanley, 1845, Proc. Zool. Soc. London, p. 106.

cf. *Ostrea cerrosensis* Gabb, 1869, Geol. Surv. Calif., vol. 2, p. 35, pl. 11, fig. 61.

Ostrea megodon Dall, 1897, Trans. Wagner Free Inst., vol. 3, pt. 4, p. 685.

Ostrea megodon Maury, 1917, Bull. Amer. Pal., vol. 5, p. 347, pl. 34, fig. 3.

This is a medium sized and sickle-shaped oyster with 4 or 5, large, tooth-like folds on the anterior and ventral margins. The beak and ligamental area are directed upwards and sometimes strongly to the posterior side. Its external surface, although strongly and deeply folded, is plain and nearly smooth.

The *Ostrea megodon* is a recent species along the west or Pacific coast of Central America. It occurs also as a Miocene fossil in Santo Domingo and in the Bowden beds of Jamaica.

Gatun Stage: Water Cay.
Coll. 4a, East Grape Point Creek.
Hill 1a, Banana River.

Ostrea costaricensis, n. sp. Plate 21, figure 2

Ostrea sculpturata Bose, 1906, Boll. de Inst. Geol. de Mexico, numero 22, p. 76, pl. 9, fig. 4. Not of Conrad, 1840.

Shell of medium size, subcircular in form but somewhat oblique; the shell is somewhat flexed or slightly saddle-shaped, the concave side of which corresponds to the left valve; both valves are strongly sculptured, the right with narrow, rib-like costæ and wider interspaces, the left valve with the reverse of the sculpture of the right; the ribs are more or less nodose or knobbed and are crossed by irregular concentric lines, which in some cases may become raised or lamellar-like; the hinge margin is irregularly crenulated.

Height 50, length 47, diameter 19 mm.

The type is a specimen from the Gatun of the Rio Blanco with both valve tightly closed so that the interior cannot be seen. What appears to be the same species, is represented by several sessile and free valves from East Grape Point Creek, and which are associated with *O. megodon.*

It differs from the *Ostrea gatunensis - haitensis* group by its smaller size; less heavy shell and in that the ribs of the valves are narrow and costæ-like and not long, strong plicæ. Bose has recorded and figured this species as *Ostrea sculpturata* Conrad from the Miocene (as Pliocene) of the State of Oaxaca, Mexico. It is very distinct from the East Coast, Chesapeake Miocene *Ostrea sculpturata* both by its form and sculpture.

Gatun Stage: Rio Blanco.
Coll. 4a, East Grape Point Creek.

The collection also contains fragments or much decayed specimens of two or more large oysters, one of which is probably the *gatunensis* Brown and Pilsbry of the Canal Zone, and a large, heavy *sellæformis*-like species, possibly the *Gilbertharrisi* Maury of the Dominican Miocene. The specimens are however too fragmentary for positive determination.

Genus **PECTEN**, Muller

Pecten gatunensis Toula — Plate 16, figures 3, 4

Pecten (*Flabellipecten*) *gatunensis* Toula, 1908, Jahrb. der K-K Geol. Reichsanstalt Wien, vol. 58, p. 711, pl. 29, fig. 2.

Pecten gatunensis Brown and Pilsbry, 1911, Proe. Acad, Nat. Sci. Phila., vol. 63, p. 365.

Shell rather large, subcircular; the left valve is nearly flat or slightly vaulted transversely across the middle of the shell; the right valve is moderately convex; the ears are small and nearly equal,those of the right valve slightly flaring at the sides; the right valve has 23 or 24 fairly strong ribs separated by interspaces a little more than ½ of their width; in large right valves, some of the central ribs become dichotomously or trichotomously divided but this feature is not always developed to the same extent on all shells; the left valve has 18 or 19 ribs which fade out on the wide dorsal submargins; the ribs of the left valve are narrow with the interspaces nearly twice as wide; the surface is covered with fine, even, raised concentric threads best preserved on the left valves; interior fluted.

Length	height	diameter
62,	60 ?	12.5 mm.
62	60 ?	4 mm (left valve)

We have redescribed this species as Toula had but a specimen of the right valve. It is a true *Pecten*, distantly related to the *Pecten hemicyclicus* Ravenel from the Chesapeake Miocene of Florida and the Carolinas, but is smaller and less broad. In both species, the ribs on the right valves of large specimens become divided in the same manner.

Gatun Stage: Gatun, C. Z.
Water Cay,

Pecten MacDonaldi, n. sp. Plate 16, figures 1, 2

Shell large, subcircular; ears of medium size and equal; left valve is slightly convex due to the middle of the shell being transversely humped or vaulted and a depressed zone follows on the inner slope of each of the raised dorsal submargins; the right valve is slightly but evenly convex; sculpture of the right valve consists of about 26, low ribs which widen out as they approach the ventral margins; their interspaces are at first nearly as wide as the ribs themselves but become only ½ or ⅓ as wide ventrally; the left valve has 21 or 22 narrow ribs and wider interspaces; on the dorsal submargins, the ribs are small and fade away; surface with fine, even, raised lines best seen on the left valve.

Length 106, height 97, semi-diameter 12 mm.
83 80 mm.

The fragmentary Toro limestone at Gatun and Toro Point contains very few good fossils, although the rock itself is composed almost entirely of broken and ground fragments of shells and barnacles. Dall has described an *Epitonium toroensis* from the Toro Point limestone where it is fairly common. The *Pecten MacDonaldi* is found in the Toro limestone which caps the hills just west of the locks at Gatun.

This species has much the same contour as the recent *Pecten maximus* Linné, from Europe. It is a larger species than the *Pecten gatunensis* Toula.

Toro Limestone. Gatun, west of the locks.

Pecten coralliphila, n. sp, Plate 17, figures 5, 6

Shell small, very thin and generally translucent; broader than high; right valve moderately convex, the left concave with raised submargins; ears small and subequal; sculpture of the right valve of about 23 low, flat ribs, with flat interspaces a little more than ½ the width of the ribs; some of the ribs may become divided medially; the ribs of the left valve, about 20 in number, are narrow, usually somewhat irregularly spaced so that their interspaces are of variable width and new ribs may occasionally appear in the wider interspaces near the ventral margin; surface in addition finely sculptured with even, raised concentric threads; interior of the shell fluted well into the cavity of the shell, in harmony with the external ribs.

Length 34, height 29, semi-diameter 4 mm (right valve)

This *Pecten* is fairly common in the coralline phases of the Miocene and its associated marls and sands. It is extremely thin and fragile in texture. Its sculpture resembles that of *Pecten gatunensis* Toula but is much more irregular. The interspaces of the left valve are of very variable width.

Gatun Stage: Port Limon.

Subgenus **CHLAMYS**, Bolton

Section **PLAGIOCTENIUM** Dall

Pecten levicostatus Toula Plate 16, figures 5-7

Pecten tevicostatus Toula, 1908, Jahrb. der K-K Geol. Reichsanstalt, Wien, vol. 58, p. 713, pl. 26, figs. 4, 5, 6.

Pecten (*Chlamys*) *santarosanus* Bose, 1906, Boll. de Inst. Geol. de Mexico, numero 22, p. 73, pl. 6, figs. 3, 4, ? *Pecten* (*Chlamys*) *santarosanus* Bose, *op. cit.* p. 23, pl. 1, figs. 1 and 4, 2 and 5.

A scallop of the general type of *Pecten ventricosus* Sowerby; both valves equally and strongly convex; ribs about 21, which are square or rectangular in section on the umbos and with deep interspaces; the ribs generally flatten or become more rounded in large shell near the ventral margins; the interspaces are covered with fine, raised, concentric lines, best seen on the umbos or on young shells; they become more crowded towards the ventral margins and may pass over the tops of the ribs as well; the dorsal and posterior submargins are strongly flattened and sculptureless; the anterior ear is a little larger, projects forward and carries, in the right valve, a byssal notch; it is sculptured with several radial riblets; the posterior ear has its upper half nearly smooth or but faintly sculptured, but its lower half carries a band of 5 or 6 strong, radial cords.

Height 29,	breadth 34,	thickness 10.50 mm	(right valve)
34	38	23	(both valves)
39	43	14	(left valve)

This is the common *Pecten* in Costa Rica and frequently forms zones in the lower part of the Gatun formation. All our specimens have 21 ribs, which vary from strongly rectangular in section with deep interspaces to more flattened and rounded on the larger individuals.

Bose has described as *Pecten santarosanus*, a small scallop shell from the Miocene of the State of Oaxaca, Mexico. The ribs number 23 to 25. Later in the same volume, he figured a larger *Pecten* from the Miocene of La Barranca de Santa Marie Tatella, as *Pecten santarosanus*. This shell has but 21 ribs and is equivalent to Toula's *levicostata*. If this larger specimen of Bose's is equivalent to his typical *santarosanus*, this name must of course take priority over Toula's *levicostatus*. As Bose's typical *santarosanus* has 23 to 25 ribs, while in *levicostatus* the ribs appear to be constantly but 21 in number, they probably represent two different species.

In the Dominican Miocene *levicostatus* is represented by the *Pecten excentricus* Gabb, which appears to differ constantly by its lower and more rounded ribs and smaller ears. The recent Pacific *Pecten ventricosus* Sowerby is closely related and probably the direct descendent of *levicostatus*. In that species, the ribs are low and rounded as in *excentricus* and as occasionally seen in large examples of *levicostatus*. The sculpture of the posterior ear is uniform. In the Chasapeake Miocene fauna the *Pecten eboreus* Conrad, variety *comparilis* Tuomey and Holmes is distantly related, but is larger, less convex and generally with more numerous ribs.

Gatun Stage: Gatun, C. Z. Quitana Creek.
Water Cay.
Hone Creek.
Banana River.
Estrella River.

Pecten costaricensis, n. sp. Plate 18, figures 8-11

Shell small, inequivalve, oblique; the right valve is moderately convex, the left but slightly; right valve with 17 flat-topped ribs, square in section and with deep U-shaped interspaces of a width equal to the ribs; these interspaces are sculptured with fine, concentric, raised lines which are quite far apart on the umbos, but become crowded ventrally or disappear entirely; the left valve has 17 or 18 ribs which are lower and more rounded in section; the fine concentric lines on the left valve are confined to the umbos, the interspaces over the greater part of the shell being smooth; the anterior and posterior dorsal slopes are flattened and smooth, but sculptured below in each valve by strong radial threads on the lower side of the ears; ears subequal; the right valve with a deep, byssal notch in its anterior ear; the left valve has the lower half of each ear with 3 strong radial threads, while on the upper half, the radial threads are largely obsolete; valves internally grooved in harmony with the external ribbing to about the center of the shell.

Height	breadth	thickness	
26.50,	28,	7.50 mm	(right valve)
24	24	4.00 mm	(left valve)
27	28	5.50 mm	(left valve)

Differs from the *Pecten levicostatus* Toula, by its unequal valves, less convexity and fewer ribs. It is somewhat like the *Pecten inæqualis* Sowerby, from which it is distinguished by its more flattened left valve and lower, smaller ribs of its right. In *inæqualis*, the fine, lamellose, concentric lines cover the entire interspaces between the ribs on both valves, while in the present species the interspaces of the left valve are largely smooth with the concentric lines confined to the extreme umbonal area.

Gatun Stage: Coll. 4, Red Cliff Creek.
1 mile south of the beach, along Old Man Sam Creek.
Coll. 4, East Grape Point Creek.
Rio Blanco.

Section **AEQUIPECTEN,** Fischer

Pecten (Aequipecten) preglyptus, n. sp. Plate 17, figures 2, 7

Shell of moderate size, subcircular in form and convex; ears of usual size, subequal and with a straight hinge-line; sculpture of about 16 or 17 wide, little elevated ribs and narrower, scarcely distinguishable interspaces; the surface is otherwise smooth or with fine, concentric lines; interior of the shell with 29 or 30 *Amusium*-like internal liræ which are evenly spaced and not in pairs; these liræ are very faint in the middle of the shell cavity but strong distally.

Length 50, height 49, semi-diameter 6.5 mm.

An *Amusium*-like species found in the lower sandstones and conglomerates of the Gatun formation in upper Cocles Creek. It is closely related to the recent deep-water *Pecten glyptus* Verrill from the cost of Hatteras and Marthas Vineyard (see Dall Proc. U. S. Nat. Mus., vol. 12, p. 248, pl. 8, figs. 2, 3), both species having about the same number of low, wide ribs and internal liræ. The fossil shell seem to have been nearly circular while *glyptus* is decidely oblique in outline.

Gatun Stage: Upper Cocles Creek.

Subgenus **PSEUDAMUSIUM**, H. and A. Adams

Section **PSEUDAMUSIUM**, s. s.

Pecten almirantensis, n. sp. Plate 18, figure 16

Shell small, thin, compressed or but slightly convex; the posterior and anterior dorsal slopes are straight, meeting the beaks at an acute angle; the right valve is finely sculptured with close, regular, concentric lamellæ and wider interspaces; the posterior and anterior sides show a few, irregular, radial threads which cross the concentric lamellæ; the ears are unfortunately broken; the interior of the shell cavity is filled with a thin deposit of callus; ventral margin plain; hinge line minutely grooved with vertical lines.

Length 4.75, height 4.75, diameter of right valve 60 mm.

This small, elegant species is represented solely by an imperfect right valve and represent the first true *Pseudamusium* to be discovered in the Miocene beds of Panama. Its sculpure is like the recent deep water *Pseudamusium strigillatum* Dall from the West Indies, but differs in having its anterior and posterior dorsal submargins meeting at the beaks at a much more acute angle.

Gatun Stage: Bocas del Toro

Section **CYCLOPECTEN**, Verrill

Pecten oligolepis Brown and Pilsbry

Pecten aff. *subhyalinus* Smith, Toula, 1911, Jahrb. der K-K Geol. Reichsanstalt, Wien, vol. 61, p. 492, pl. 31, figs. 1a, b, c.

Pecten (*Cyclopecten*) *oligolepis* Brown and Pilsbry, 1912, Proc. Acad. Nat. Sci. Phila., vol. 64, p. 512, text-figure 5.

A very small species with broad, nearly smooth valves and large ears. The right anterior ear has a deep byssal notch and its surface is sculptured with fine, raised, concentric, lamellose lines. The ears of the left valve are similiarly sculptured but finer. The surface of the valves appear nearly smooth but in well-preserved specimens very faint concentric lines and fine radial striæ may be seen. The left valve is more coarsely sculptured. The hinge is finely grooved with vertical lines. The measurements given by Pilsbry for his Gatun specimen, length 2.8, height 2.7, diameter of right valve .8 mm, are the usual dimensions for the Costa Rican specimens.

Gatun Stage: Gatun, C. Z.
Coll. 4, East Grape Point Creek.
Middle Creek.

Pecten aotus, n. sp. Plate 18, figures 17, 18

Shell small, thin, depressed or but slightly convex and *Amusium*-like; both valves except on magnification appearing smooth; ears of the left valve large and subequal; the anterior ear of the right valve about twice that of the posterior and carrying a deep, byssal notch; the surface of the left valve on magnification is seen to be sculptured with fine, radial lines which often occur in irregular streaks or blotches, imparting a peculiar appearance to the shell; the right valve is perfectly smooth and featureless, except for a band of rough scales on its anterior ear above the byssal notch; interior of shell cavity shallow, a simple ventral margin and the hinge-line vertically grooved with fine lines.

Length 4.5, height 4.5, diameter .75 mm. left valve.

Differs from *Pecten oligolepis* Brown and Pilsbry in its larger size, thinner and more *Amusium*-like shell, and strongly sculptured left valve. This sculpture consists of fine lines or *camptonectes* striations, which may be uniformly distributed but more usually occur in irregular streaks or blotches, imparting a distinctive appearance to the surface. This sculpture is seen only on a slight magnification, the shell otherwise appearing smooth and featureless. It is quite common in the coralline limestones of Port Limon.

Gatun Stage: Port Limon.
Coll. 5, Red Cliff Creek

Genus **AMUSIUM,** Bolton

Amusium luna Brown and Pilsbry Plate 17, figure 1

Amusium Mortoni Bose, 1906, Boll. de Inst. Geol. de Mexico, Numero 22, p. 24, pl. 1, figs. 3, 6, 7, 9. Not *Amusium Mortoni* Ravenal, 1844,

Amusium Mortoni Bose, *op. cit.* p. 74, pl. 8, figs. 1, 2; pl. 3, fig. 3.

Pecten (*Amusium*) cf. *Mortoni* Toula, 1908, Jahrb. der K-K Geol. Reichsanstalt, Wien, vol. 58, p. 714, pl. 26, figs. 8, 9.

Pecten (*Amusium*) *luna* Brown and Pilsbry, 1912, Proc. Acad. Nat. Sci. Phila., vol. 64, p. 514, pl. 23. fig. 1.

This is the common Gatun *Amusium* in Panama and Costa Rica. Its valves are nearly equal and but slightly convex; ears equal and small, and defined from the rest of the shell by a sharp ledge; the umbos, as well as the rest of the shell disk are smooth, except for the faint lines of growth; the internal ribs are in pairs, numbering about 23 and spaced at intervals nearly twice the width of the pairs of ribs themselves.

Bose and Toula both referred this species to the Upper Chesapeake Miocene and recent *Amusium Mortoni* Ravenel, from which it is very distinct. *Amusium Mortoni* is not only much larger (height 170 mm), but is porportionately much broader, and with larger ears which are defined simply by a line from the rest of the shell.

The Dominican *A. papyraceum* Gabb has larger ears, the internal ribs are more crowded and the left valve is generally strongly flexed along the anterior and posterior submargins. *Amusium Toulæ* Brown and Pilsbry, is found in the Gatun of the Canal Zone. Its surface is marked with dark-colored rays and is said to contain no internal ribs.

Gatun Stage: Gatun, C. Z.
Hotel Creek.
Zone 6, Old Man Sam Creek.
Coll. 4, East Grape Point Creek.

Amusium bocasensis, n. sp. Plate 17, figures 3, 4

Shell rather small, thin and subcircular in outline; moderately convex; ears proportionately larger than in *A. luna*, and with their dorsal margins slightly inclined upwards from the beaks to their outer edges; the surface is smooth and polished, finely covered with concentric growth-lines and faintly showing the position of the internal liræ; interior of shell with about 34 liræ, which are usually nearly evenly spaced and not in pairs; the internal liræ commence well in the interior of the shell, but are strongest distally.

Height 40, breadth 43.
35 38, thickness 6 mm. (right valve)

A much smaller and more delicate species than the *Amusium luna* Brown and Pilsbry. The internal liræ are more or less equally spaced and not in pairs. It differs from *Amusium Lyonii* Gabb from the lower Miocene of Sapota, Costa Rica by its much smaller ears.

Gatun Stage: Bocas del Toro.

Genus **SPONDYLUS**, Linnæus

Spondylus chiriquiensis, n. sp. Plate 20, figures 1, 2, 5, 6

Shell large, ponderous, equivalve and strongly convex; both valves of the same convexity, but with the beak of the right, high and projecting above the strongly incurved beak of the left; in large shells both valves are provided with a cardinal area, that of the right being both high and wide and for the greater part straight but the beak curving over it to a small extent at its upper end; the cardinal area of the left vale is much smaller, narrow and appears only with maturity and is more or less hidden by the strongly incurved beak; the sculpture consists of strong radial cords and small ribs divisible into 3 sets; a primary set of 7, which in perfect specimens and in the young carry large, strong spines; a secondary thread in each of the wide interspaces and when perfect bearing smaller spines, and tertiary threads of a variable number between the secondaries and primaries; the whole surface is in addition, finely, longitudinally starited with minute, scale-bearing threads; young shells have a small foliaceous area on the umbo of the sessile or right valve and strong spines on both valves.

Height 151, length 120, diameter 115 mm.

A large, ponderous species with nearly equal and strongly convex valves which show no distortion due to attachment Young shells associated with the type have a small, somewhat foliaceous attachment area on the right valve, and each valve bears large, strong spines on its primary set of radial cords and finer spines on its secondary and even on some of the tertiary threads.

Of described species, the *chiriquiensis* seems nearest related to the *bostrychites* Guppy from the Miocene of Santo Domingo and Jamaica but differs by its much larger size, proportionately more convex whorls and by its cardinal area which is more upright and with a more incurved beak at its upper end. The sculpture of *chiriquiensis* is more spiny, the spines being borne by the primary radials and to a less degree by the secondaries, and even by the tertiaries. In *bostrychites* only the primaries bear spines, the others appearing as large, nearly smooth, intermediate threads and cords. We have specimens of a large, closely allied *Spondylus* from the Chesapeake Miocene of Florida, differing mainly in its cardinal area and in details of sculpture.

Gatun Stage: Water Cay.

Spondylus gumanomocon Brown and Pilsbry Plate 21 figure 1

Spondylus americanus Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 257. Not of Lamarck.

Spondylns gumanomocon Brown and Pilsbry, 1912, Proc. Acad. Nat. Sci. Phila., vol. 14, p. 514, footnote.

Spondylus gumanomocon Maury, 1917, Bull. Amer. Pal., vol. 5, p. 355.

This is a species with very unequal valves, that of the left or upper, being small, pectiniform and lacking in a cardinal area, while the right or lower valve is strongly convex, with a high produced beak and a high cardinal area. The sculpture of the two valves is similiar, except that the umbo of the right is strongly foliaceous. It occurs in the Miocene of Santo Domingo, where it was referred to the recent *S. americanus* by Gabb.

Gatun Stage: Coll. 2, Hone Walk Creek.
Port Limon.

Genus **PLICATULA**, Lamarck

Plicatula marginata Say Plate 28, figures 6, 7

Plicatula marginata Say, 1824, Journ. Acad. Nat. Sci. Phila., vol. 4, pp. 136-137, pl. 9, fig. 4.

Plicatula marginata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 764.

The Panama and Costa Rican examples are not typical but they approach more closely the *Plicatula marginata* Say than they do the *densata* which Dall has recorded from the Bowden beds of Jamica.

The shells vary from subcircular to elongate and in some cases carry the dark, marginal band so frequently seen in typical *marginata*. The ribs number five to seven; the shells with more rounded form and more numerous ribs suggest the *densata*, but the ribs are higher and more foliaceous, and can be exactly duplicated by scores of true *marginata* in the Cornell collection. The above determination must however be considered as purely provisional at the present time.

The typical *P. densata* was described by Conrad from the lower Chesapeake Miocene of New Jersey, but it also occurs in the synchronous Calvert formation of Maryland. It is also found as a lower Miocene fossil in Florida and Dall recorded it from the Bowden beds of Jamaica and from the Oligocene of Gual-lava, Costa Rica. The *P. marginata* Conrad is an Upper Cheapeake Miocene and Pliocene fossil of the eastern United States.

Gatun Stage: Water Cay,
Old Man SamCreek, 1 mile south of the beach.

Genus **LIMAEA**, Born

Limaea solida Dall Plate 28, figure 10

Limæa solida Dall, 1898, Trans, Wagner Free Inst. Sci., vol. 3, pt. 4, p. 769, pl. 35, figs. 4, 5.

A small, solid shell, externally sculptured like a small *Glycymeris.* It has 12 rounded ribs and a coarsely crenulated basal margin. Our single specimen from Costa Rica is a little smaller than Dall's specimens from Bowden.

Gatun Stage: Coll. 4, Red Cliff Creek.

Genus **ANOMIA**, (Linné) Muller

Anomia simplex d'Orbigny Plate 21, figure 6

Anomia ephippium Conrad, 1845, Fossils of the Medial Tertiary, p. 75, pl. 43, fig. 4. Not of Linné.

Anomia simplex d'Orbigny, 1845, Hist. Pol. y Nat. Isla de Cuba, p. 367.

Anomia ephippium Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 257.

Anomia simplex Dall, 1898, Trans. Wagner Free Inst., Sci., vol. 3, pt. 4, p. 784.

Anomia simplex Bose, 1906, Boll. de Inst. Geol. de Mexico, numero 22, p. 25, pl. 2, figs. 18-23.

Anomia simplex Maury, 1917, Bull. Amer. Pal., vol. 5, p. 355, pl. 26, fig. 15.

The *Anomia simplex* is both common and characteristic in the Gatun of Costa Rica as well as in certain parts of the Province of Colton, Panama, near the Canal Zone. It frequently gives rise to important zones in the lower part of the Gatun formation, where it occurs in large numbers associated with *Pecten levicostatus* Toula.

The specimens are generally large, thin-shelled, smooth and irregular in form, due to the object on which they were attached. They average for the upper valves about 35 mm in height.

Anomia simplex appears as a Miocene fossil in the eastern United States for the first time in the St. Mary's formation of Maryland in the upper part of the Lower Chesapeake. It occurs throughout the Upper Chesapeake Miocene and Pliocene and passes into the recent fauna. Locally as a fossil it may become very abundant, as at the base of the Pliocene overlying Upper Chesapeake Miocene along the shores of Lake Waccamaw, North Carolina. It occurs rarely as a Miocene fossil in Santo Domingo, where it has been recorded by Gabb and Maury. In Mexico, it occurs in the Miocene of Santa Rosa, Vera Cruz as figured by Bose.

Gatun Stage: Several localities, Prov. of Colon, Panama.
Middle Creek. Comadre Creek.
Hone and Hotel Creeks.
Hill No. 2, Banana River, Soury Creek, etc.

Genus **PLACUNANOMIA**, Broderip

Placunanomia lithobleta Dall Plate 21, figures 3, 4, 5

Placunanomia lithobleta Dall, 1898, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 778.

Placunanomia lithobleta Maury, 1917, Bull. Amer. Pal., vol. 5, p. 356, pl. 34, figs. 1, 2.

The Costa Rican specimens are frequently widely plicate, nearly as much as in the Duplin Miocene *P. plicata* Tuomey and Holmes, but the surface is marked with fine, wavy, radial threads so that even very small fragments of this species are very easily recognized. It occurs in the Miocene of Jamaica, its type locality, and in the Miocene of Santo Domingo.

Gatun Stage: Hill 3, Banana River.

ORDER ANOMALODESMACEA

Genus **THRACIA,** Blainville

Subgenus **CYATHODONTA**, Conrad

Thracia Tristani, n. sp. Plate 20, fig. 3

Shell thin, subquadrate, the left valve slightly convex; the beaks situated at the posterior 1-3 of the shell, are low and inconspicuous; anterior end, wide and broadly rounded, the posterior contracted, depressed and truncated at its extremity; the surface is sculptured with regular wave-like folds, which on the middle of the shell are concentric, but are oblique on the anterior portion; they are lacking from the posterior area; in addition the whole surface is very finely pustulose and crossed by very indistinct growth-lines.

Length 42, height 30, diameter of the left valve 7.00 mm·

The *Cyathodonta gatunensis* Toula of the Canal Zone is a similiar but larger species, reaching a length of 52 mm. It differs from the Costa Rican species in its greater proportional length, the more central beaks and in its sculpture, which according to Toula's figure is strictly concentric.

The *C. undulata* Conrad, a recent species from the Gulf of California, is sculptured like *Tristani* with oblique riblets but the left valve is depressed and strongly flattened.

This species is named for Professor J. Fidel Tristan, Director of the National Museum of Costa Rica.

Gatun Stage: Rio Betey.

ORDER TELEODESMACEA

Genus **CRASSATELLITES,** Kruger

Crassatellites Reevei Gabb Plate 20, figure 4

Crassatella antillarum Reeve ? *C. Reevei* Gabb 1873, Trans. Amer. Phil. Soc. vol. 15, p. 252.

Crassatellites reevei Brown and Pilsbry, 1913, Proc. Acad. Nat. Sci. Phila., vol. 64, p. 515, pl. 23, fig. 5.

The *Crassatellites Reevei* Gabb is not an uncommon fossil in the Gatun beds of western Panama and Costa Rica. Our specimens agree quite closely with Brown and Pilsbry's figure of the single right valve collected by Gabb in the Miocene of Santo Domingo. Young and full-grown specimens show a strong posterior angulation which extends from the beak to the posterior ventral extremity. The posterior end is obliquely truncated but less so in young shells. The surface sculpture consists of even, concentric costæ which on the slightly flattened umbos are a little wider apart as in the *Crassatellites* of the section *Scambula* Conrad. In this later character, our shells disagree with Brown and Pilsbry's redescription of Gabb's type specimen, in which the sculpture is said to extend without any irregularity upon the rather flattened umbos.

The *C. mediamericanus* Brown and Pilsbry from Sapote, Costa Rica is an earlier shell and is higher, less obliquely truncated behind, more coarsely sculptured and lacks the posterior angulation. In these characters except the lack of the posterior-umbonal angulation it is like the young shells of *Reevei*.

Length 55,	height 36.5,	semi-diameter	10.5	mm.
50	35	diameter	21	mm.
58	42	semi-diameter	14	mm.

Gatun Stage: Water Cay.
Old Man Sam Creek, Coll. No. 6.
Banana River.

Subgenus **CRASSINELLA**, Guppy

Crassatellites bowdenensis Dall, variety **costaricensis, n. var.**

Plate 29, figure 12

Cf. *Crassatellites* (*Crassinella*) *bowdenensis* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1476, pl. 50, figs. 2, 3.

Shell small, triangular, slightly convex, subequilateral, the anterior end generally a little longer and more pointed; beaks triangular, slightly pointing forwards; lunule large, narrowly lanceolate, smooth; escutcheon small; surface sculptured with small, even, concentric riblets which on some shells may be strong and persistent over the greater part of the shell, or on some specimen sub-obsolete; interior of shell cavity shallow, with a moderately heavy hinge.

Length 3.00,	height 2.75,	diameter .75 mm.
3.50,	3.50,	.75 mm.

The typical *bowdenensis* Dall from the Bowden Miocene of Jamaica is a more solid, more convex and triangular shell. The variety *costaricensis* is very abundant at several localities in Costa Rica in certain horizons. The sculpture varies from strong, even, concentric riblets covering the greater part of the shell, to forms which are nearly smooth.

Gatun Stage: Hill 1a, Banana River.
Middle Creek.
Zone 3, Quitana Creek.

Crassatellites midiensis, n. sp. Plate 29, figure 11

Shell small, trigonal, slightly convex and equilateral; the beaks are central and erect; the dorsal margins straight and meeting at the beaks nearly at right angles; the surface is sculptured with subregular, distant, concentric lamellæ-like riblets, numbering about 10; the interspaces carry irregular, finer, concentric lines; lunule narrowly lanceolate, with the escutcheon narrow and smaller; interior of shell cavity shallow, with a moderately heavy hinge.

Length 3.25, height 3.25, diameter of one valve 1.00 mm.

A small, rare species, somewhat like the *C. Guppyi* Dall of the Miocene of Jamaica, but more trigonal, with more central beaks and somewhat different sculpture. The sculpture and form are very similar to specimens of *C. galvestonensis* Harris in the Cornell Collection from the Chesapeake Miocene of Yorktown, Va. This latter species is generally much worn but perfect specimens have a coarse concentric sculpture like that of *lunulatus* Conrad. The Costa Rican shells are however very much smaller.

Gatun Stage: Middle Creek, C. R.
Coll. 4, East Grape Point Creek.
Water Cay, Panama.

Genus **CARDITA**, (Bruguière) Lamarck

Cardita caribbeanensis, n. sp. Plate 26, figure 22

Shell small, moderately convex, elongate, its length a little less than twice its height; beaks very near the anterior end are small but distinct; an umbonal ridge extends from the beaks to the posterior-ventral extremity and along which and bordering the ribs are largest; the right valve with about 20, hight, narrow and sharply nodulose ribs, separated by wide, triangular, smooth interspaces; 6 of the ribs are situated on the posterior-dorsal submargins, and of which the 4th and 5th from the dorsal margin are much smaller than the others; of the remaining ribs, the largest are found on the umbonal ridge, and become progressively smaller anteriorly; lunule small but distinct; hinge of the right valve that of typical *Cardita*, with 3 cardinal teeth of which the middle one is much the largest, no laterals; ventral margin, internally fluted in harmony with the external ribs.

Length 18, height 12.50, diameter of the right valve 5.50 mm.

This small species represented by a single right valve in our collection appears to be a true *Cardita*, its hinge being essentially that of the recent West Coast *Cardita laticostata* Sowerby. With the exception of a few doubtful species in the Eocene of United States, true *Cardita* has heretofore not been found as a fossil in the Americas and its recent American species are confined to the Pacific coast.

Compared with the recent *Cardita laticostata* Sowerby, which is abundant along the Pacific Coast of Panama, the fossil shell differs in its smaller size, smaller umbos and in form. Its lunule is like that of *laticostata*.

Gatun Stage: Banana River.

Section **CARDITAMERA,** Conrad

Cardita matima, n. sp. Plate 32, figure 8

Shell robust, solid, strongly inequilateral with the beaks situated at the anterior extremity of the shell; umbos large and full with strongly curved beaks above the small, sunken lunule; outline of the shell from within is subrectangular with straight ventral and posterior sides which meet at nearly right angles; sculpture of about 18 strong, heavy cord-like ribs, separated by interspaces 1-3 of their width; the ribs are strongly nodulated on the disk and umbonal portion of the shell, but below they are simply irregularly wrinkled; a deep furrow extends from the beaks to the posterior extremity, just above the umbonal angle; the rib forming the summit of the ridge between the umbonal furrow and the hinge-line is larger than those on each side; shell cavity deep with a crudely denticulated ventral and posterior margin; hinge large (broken in our specimen), with a well-developed anterior lateral tooth in its left valve.

Length 30, height 25, semi-diameter 12 mm.

But a single specimen of this very distinct spceies was collected by Dr. A. C. Veatch from the Upper Gatun of Old Man Sam Creek in eastern Costa Rica. It differs from the other known American Carditameras by its convex shell and strongly curved beaks. The ribs are large and strongly nodulated at first, becoming irregularly wrinkled near the ventral margin. The hinge is unfortunately broken on our specimen, a left valve, but the small anterior lateral still remains which shows this shell to belong to the section *Carditamera*

Gatun Stage: Old Man Sam Creek, 1 mile south from shore.

Genus **VENERICARDIA**, Lamarck

Venericardia scabricostata Guppy Plate 32, figures 14, 17

Cardita scabricostata Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p. 293, pl. 18, fig. 10.

Cardita scabricostata Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 252.

Venericardia scabricostata Maury, 1917, Bull. Amer. Pal., vol. 5, p. 362, pl. 33, fig. 1.

This species originally described by Guppy from the Bowden beds of Jamaica is common in the Miocene of Costa Rica and frequently forms small zones in the Gatun beds. It occurs also in the Miocene of Santo Domingo.

The ribs numbering about 18 are high, narrow and strongly granulated. The interspaces are wide and generally smooth.

Gatun Stage: Zone E, G, Saury creek.
Zone 1, 3, East Grape Point creek.
Coll. 5, Red Cliff creek.
Headwaters of Middle creek.
Coll. C, Comadre creek.

Venericardia Terryi, n. sp. Plate 32, figures 12, 13

Shell of medium size, solid, moderately convex and sub-circular in form; beaks situated well forward and but slightly back of the extreme anterior end of the shell; the beak itself is small and loosely coiled over the small sunken lunule; sculpture consists of about 13, low, wide, smooth ribs which fit so closely together that there are no interspaces between them; the ribs are rounded in section on the umbos, wide and low ventally; the ribs are largest about the middle, small and fading away on the posterior and anterior dorsal submargins; interior concealed in a hard sandstone matrix.

Length 22, height 21, semi-diameter 6 mm.

The first specimens of this interesting species was collected by Mr. R. Terry from some Gatun sandstones in Quitana Creek, a small tributary streams of the Rio Betey. In that locality, it is an abundant species and occurs in small zones.

It is related to the recent Pacific, *V. crassicostata* Sowerby but is a much smaller species.

Gatun Stage: Quitana Creek.
Hill No. 3, Banana River.

Subgenus **PLEUROMERIS**, Conrad

Venericardia Conradiana Gabb, var. **limonensis**, n. var. Plate 26, figs. 19, 20

Cardita Conradiana Gabb, 1881, Journ. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 377, pl. 47, fig. 79.

Shell small, subcircular, moderately convex; umbos high and prominent, with small, inconspicuous beaks at the anterior 1-3 of the shell; the sculpture consists of about 18 heavy, granulated ribs, separated by somewhat narrower interspaces; interior of the shell deep, the hinge with 2 cardinal teeth and a small posterior and anterior lateral.

Length 7.00, height 7.00, diameter of the left valve 3.00 mm.

Gabb specimen described from the Pliocene beds of the Limon Peninsula, measures 1½ mm in length. His enlarged figure is very similiar to the present shell, in its subcircular form and in number of ribs. The figure of the hinge shows the two cardinal teeth but no laterals.

The common *tridentata* Say of the Upper Chesapeake Miocene and recent fauna of the West Indies differs mainly in its more triangular form.

Gatun Stage: Port Limon.

Genus **CHAMA**, (Linné) Bruguière

Chama congregata Conrad Plate 28, figure 11

Chama congregata Conrad, 1833, American Journal of Science, vol. 23, p. 341.

Chama congregata Conrad, 1838, Fossils of the Medial Tertiary, p. 32, pl. 17, fig. 2.

Chama congregata Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1400.

Chama congregatoides Maury, 1917, Bull. Amer. Pal., vol. 5, p. 200, pl. 33, fig. 8.

Our specimens from Costa Rica are all small and belong to the upper or free valve, which in this species is the right. These specimens cannot be distinguished from true *congregata* of the same size from the eastern United States, where it is an abundant fossil throughout most of the Chesapeake Miocene. The upper or right valve is finely, radiately frilled or fluted and these frills are cut by the concentric lamellæ. The attached or left valve is more coarsely sculptured, both radially and concentrically.

Gatun Stage: Water Cay.
Coll. 4, Red Cliff Creek.

Genus **ECHINOCHAMA**, Fischer

Echinochama antiquata Dall Plate 28, figure 8

Chama antiquata Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p. 294. Not of Linné.

Echinochama antiquata Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1404, pl. 54, fig. 9.

Not *Echinochana antiquata* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 365, pl. 33, fig. 10. *E. yaquensis* Maury.

This species described by Dall from the Bowden beds of Jamaica differs from the common, recent *arcinella* Linné of the West Indies, by its more numerous, irregular and lower ribs which bear only small, short spines. In *arcinella* the middle ribs are heavy and bear large, stump-like spines and the wide interspaces are reticulated with a coarse, mesh-like sculpture.

Gatun Stage: Middle Creek,
Coll. 6, Old Man Sam Creek.
Hill No. 1, Banana River.
Rio Blanco.

Echinocama yaquensis Maury Plate 28, figure 5

Chama arcinella Moore, 1853, Quart. Journ. Geol. Soc. London, vol. 9, p. 130. Not of Linné.

Chama arcinella Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 251.

Chama arcinella Guppy, 1874, Quart. Journ. Geol. Soc. London, vol. 32, p. 531.

Echinochama antiquata Maury, 1917, Bull. Amer. Pal., vol. 5, p. 365, pl. 33, fig. 10. Not of Dall.

Echinochama antiquata var. *yaquensis* Maury, 1917, *op. cit.* p. 365, pl. 33, figs. 11, 12,

Echinochama trachyderma Pilsbry and Johnson, 1917, Proc. Acad. Nat. Sci. Phila., p. 197.

The *Echinochama yaquensis* Maury from the Miocene of Santo Domingo, where it is the prevaling species, differs from the *antiquata* by the reduced number of its ribs, which in some cases are nearly obsolete and in having its surface covered with a coarse, mesh-like sculpture of raised pustules.

In Costa Rica, the *antiquata* is the common species, but we have also a single species of *yaquensis* collected from the lower Gatun near Old Harbor.

Gatun Stage: Old Harbor.
Gatun, C. Z.

Genus **DIPLODONTA**, Brown

Section **DIPLODONTA**, s. s.

Diplodonta collina, n. sp. Plate 32, figure 15

Shell small, subcircular, convex; umbos wide, with small inconspicuous beaks, slightly posterior of the middle; anterior and posterior extremities well rounded into the base forming a part of the same circle; surface sculptured with fine, even, concentric threads which are nearly lacking from the smooth umbos; hinge normal, and a plain ventral margin.

Length 6.75, height 6.75, diameter of the right valve 1.60 mm.

A small shell resembling the *Diplodonta nucleiformis* Wagner of the Upper Chesapeake Miocene and the recent West Indian fauna, but less convex and more finely sculptured.

Gatun Stage: Middle Creek.

Section **FELANIELLA**, Dall

Diplodonta insula, n. sp. Plate 32, figure 21

Shell small, slightly convex, subcircular; beaks slightly posterior of the middle so that the posterior is a little longer than the anterior; beaks low and inconspicuous; both anterior and posterior extremities widely rounded, the posterior and the ventral margin forming a part of the same circle; surface with fine, concentric threads heaviest on the extremities, but nearly lacking from the umbonal area; interior of shell shallow, the right valve with a strongly bifid posterior cardinal; ventral margin plain.

Length 6.60, height 6.50, diameter of the right valve 1.25 mm.

A small, subcircular shell, neatly sculptured with fine, concentric threads. *D. minor* Dall from the Bowden beds is strongly oblique.

Gatun Stage: Water Cay.

Genus **MYRTAEA**, Turton

Myrtaea limoniana Dall Plate 32, figures 11, 23

Myrtæa limoniana Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1358, pl. 52, fig. 10.

A small, thin and slightly convex shell, its surface sculptured with fine, thin and sharp, elevated, concentric lamellæ. We have several specimens from the coral limestones of Port Limon as well as a larger specimen from Zone 4, of Red Cliff Creek. This later shell measures: heigth 9.50, length 10.00, diameter of the right valve 2.50 mm. It occurs also in the Bowden beds of Jamaica.

Gatun Stage; Port Limon.
Coll. 4, Red Cliff creek.

Genus **PHACOIDES**, Blainville

Subgenus **CALLUCINA**, Dall

Phacoides radians Conrad, var. **medioamericanus**, n. var. Plate 32 fig. 16

The *Phacoides radians* Conrad is a fossil of the Upper Chesapeake Miocene of the Carolinas but has continued through the Pliocene to the recent fauna. The Costa Rican fossils differ from typical *radians* in having their umbos sculptured with about 6 ribs much stronger than the concentric, while in typical *radians*, the ribs are more numerous and about equal to the concentric lines. The *medioamericanus* is also smaller as may be seen in the measurements given below, while *radians* is large (20 mm) and often quite convex.

Length 9.5, height 9, semi-diametes 2.5 mm.

Gatun Stage: Headwater of Middle creek.
Old Man Sam creek, 1 mile south of the beach.

Subgenus **HERE**, Gabb

Section **CAVILUCINA**, Fischer

Phacoides trisulcatus Conrad

Lucina trisulcata Conrad, 1841, Trans. Amer. Assoc. Nat. and Geol., vol. 1. p. 110.

Lucina trisulcata Conrad, 1845, Fossils of the Medial Tertairy, p. 71, pl. 40, fig. 5.

Phacoides (*Cavilucina*) *trisulcatus* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1369.

Few specimens from the Gatun of Middle Creek. They are identical with typical specimens from the Chesapeake Miocene of the eastern United States. The species also occurs in the recent fauna.

Gatun Stage: Middle creek.
Old Man Sam creek.

Subgenus **LUCINISCA**, Dall

Phacoides costaricensis, n. sp. Plate 32, figure 5

Shell subcircular, moderately thick and but slightly convex: beaks small and inconspicuous, a little in front of the middle; dorsal area impressed and well defined; sculpture consists of strong, regular, radial threads, widely separated by interspaces 2 or 3 times the width of the threads themselves; they are crossed by distant but regular concentric ridges, the intersection forming small beads or granulations, strongest on the anterior and posterior extremities; the lunule is narrow, lanceolate and with the concentric sculpture predominanting; interior of shell cavity rather shallow, the ventral margin coarsely serrated by the external sculpture.

Length 11.50, height 11.00, diameter of the left valve 2.25 mm.

This species is recognized by its depressed or but slightly convex shell and coarse sculpture, of which the radial is a little stronger. *Phacoides cribrarius* Say and *nassula* Conrad are both more convex, with the concentric lamellæ more distantly spaced on the umbos and dominating over the radial. *P. muricatus* Spengler of the West Indies is much more finely sculptured.

We have also a young shell from Water Cay which is possibly *P. nassula*, var. *caloosana* Dall of the Florida Pliocene. It is very close to specimens of that species in the Cornell collection.

Gatun Stage: Middle creek.

Phacoides bocasensis, n. sp. Plate 32, figure 6

Shell thin, subcircular, depressed; dorsal area well defined by a marked change in sculpture; beak small, but distinct, placed a little in front of the middle; the sculpture on the disk of the shell is fine, composed of subequal, radial threads, separated by narrow interspaces; the ribs and interspaces are crossed by fine, concentric threads or ridges which produce a finely scabrous surface; the concentric threads are a little more widely spaced on the umbos; the dorsal area is defined by a stronger radial, beyond which follows a wide radial band, strongly sculptured with the concentric threads or lamellæ but lacking in radials; the upper half of the dorsal band bears in addition to the concentric lamellæ, 2 or 3 weak but scabrous radial threads; the lunule is very narrow, lanceolate and with a few strong, concentric lamellæ; interior of the shell cavity shallow, with the ventral margin finely crenulated.

Length 10.00, height 9.25, diameter of the left valve 2.00 mm.

A depressed and very finely sculptured species whose general form is that of *P. muricatus* Spengler of the recent West Indian fauna. It is more regularly sculptured than the *P. hispan-*

iolana Maury of the Cercado formation of Santo Domingo but the main difference lies in their dorsal areas, that of *hispaniolana* Maury being sculptured more or less like the rest of the shell; in *bocasensis*, as described above, the sculpture of the dorsal area is dominantly concentric, only the upper half bearing 2 or 3, low but scabrous radials.

Gatun Stage: Bocas del Toro.

Subgenus **PARVILUCINA**, Dall

Section **BELLUCINA**, Dall

Phacoides actinus Dall Plate 32, figure 24

Phacoides (*Bellucina*) *actinus* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1385, pl. 52, fig. 3.

Dall gives for his typical specimens from the Bowden beds of Jamaica, a height of 4.50 mm, while the Panama shells, all from Bocas Island, do not exceed 3 mm in height but agree in other respects. It is also recorded by Maury from the upper part of the Cercado formation of Santo Domingo.

Gatun Stage: Bocas del Toro.

Genus **DIVARICELLA**, von Martens

Divaricella quadrisulcata d'Orbigny Plate 32, figure 20

Lucina divaricata Conrad, 1840, Fossils of the Medical Tertiary, p. 39, pl. 20, fig. 3, but not of Linné.

Lucina quadrisulcata d'Orbigny, 1846, Voy. Am. Mer., p. 584.

Divaricella quadrisulcata Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1389.

Lucina (*Divaricella*) *quadrisulcata* Bose, 1906, Boll. de Inst. Geol. de Mexico, numero 22, p. 77, pl. 11, figs. 2, 3.

This species is very rare in Costa Rica. The shells are rather thin and generally more finely sculptured and approach in this respect the *D. compsa* Dall of the Florida Pliocene. Our larges specimen measures: height 14 m, length 10 mm, diameter of left valve 4.50 mm. The *D. prevaricata* Guppy of the Miocene of Santo Domingo and Jamaica measures only 8 mm in height.

The *D. quadrisulcata* is a recent species of the West Indies appearing in the east coast Miocene of the United States for the first time in the Upper Chesapeake.

Gatun Stage: Coll. 4, 5, Red Cliff creek.
Middle creek.

Genus **CARDIUM**, Linné

Subgenus **TRACHYCARDIUM**, Moerch

Cardium stiriatum Brown and Pilsbry Plate 27, figures 4, 5

Cardium (*Trachycardinm*) *stiriatum* Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 366, pl. 28, fig. 11.

This is most elegant of the several species of *Cardium* in the Miocene of Panama and Costa Rica. The shell is high and inflated with about 30 radial ribs which are peculiarly sculptured with twisted or obliquely projecting tuberclers placed on the posterior side of the ribs and overhanging the adjacent interspace. Large specimens may reach a height 50 mm. It is related to the recent West Coast *Cardium belcheri* Broderip.

Gatun Stage: Gatun, C. Z.
Water Cay, Panama.
Hill No. 1, Banana River.

Cardium dominicense Gabb Plate 27, figure 2

Cardium)*Trachycardium*) *dominicense* Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 25.

Cardium (*Trachycardium*) *dominicense* Gabb, 1881, Journ. Acad. Nat. Sci. Phila., 2nd series, vol. 8, p. 344.

Cardium (*Trachycardium*) *gatunensis* Toula, 1908, Jahrb. der K-K Geol. Reichsanstalt Wien, vol. 58, p. 720, pl. 27, fig. 4. Not *Cardium* (*Fragum*) *gatunensis* Dall, 1900.

Cardium (*Trachycardium*) *dominicense* Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 367.

A large species abundant in the Canal Zone but usually only as internal casts. It appears to be rare in Costa Rica, our collection containing only a few fragments of a large individual from East Grape Point Creek. It is distinguished not only by its large size, but very numerous (60+) fine ribs.

Gatun Stage: Gatun, C. Z.
East Grape Point Creek, C. R.
Sapote, C. R. (*Gabb*)

Cardium costaricanum, n. sp. Plate 27, figure 3

Shell ovate, solid, inflated; umbos wide and full with high beaks; sculpture of about 24 strong ribs, rounded or subtriangular in section with their apex leaning posteriorly except those on the posterior slope which lean anteriorly; interspaces narraw, formed by the sides of the ribs; the ribs are mostly smooth except those on the anterior half of the shell which have their posterior side more or less granulated; this granulation is found also on a few of the central ribs near their ventral margin; hinge narrow; internal margin fluted in harmony with the external ribs.

Length 24.50, height 34, semi-diameter 15 mm.

This species is not uncommon in Costa Rica and may easily be confused with the *C. dominicanum* Dall. It differs in its larger side, narrow umbos, more pointed beaks and more flattened ribs.

Gatun Stage: Coll. 4, East Grape Point Creek.

Subgenus **FRAGUM**, Bolton

Cardium medium Linnæus Plate 27, figure 6

Cardinm medium Linnæus, 1758, Sys. Nat. ed. 10, p. 678.

Cardium medium Reeve, 1844, Conch. Icon., *Cardium*, pl. 6. fig. 30.

Cardium (*Fragum*) *medium* Dall, 1900, Trans. Wagner Free Inst. Sci., vol. 3, pt. 5, p. 1101.

A recent West Indian species but also common as an Upper Miocene and Pliocene fossil along the Atlantic coastal plain of eastern United States. The ribs number 24 to 27 in front of the umbonal angle. Dall has described a *Cardium* (*Fragum*) *gatunensis* from Gatun, on which the ribs number only 16 in front of the truncation and 10 behind.

Gatun Stage: Port Limon.

Section **TRIGONIOCARDIA** Dall

Cardium heredium, n. sp. Plate 27, figure 10

Shell small, solid, oblique, convex and subquadrate; strongly carinate on the posterior-umbonal slope and truncated; umbos high and prominent; shell sculptured anterior to the truncation with 12 or 13 strong ribs, separated by interspaces about ½ to ⅓ as wide; there are 7 or 8 smaller ribs on the posterior truncation; the interspaces are finely sculptured with small, elevated cross-threads; the anterior set of ribs on the type specimens are wide, subequal and smooth; the posterior are unequal, with the three, bordering the umboal angulation much the smaller and bearing small and scattered pustules; on the posterior ribs where the pustules are lacking, are small dot-like depressions.

Height 11.50, length 11.50, diameter 6.00 mm.

This species approaches the *Cardium apateticum* Dall from the Oak Grove sands of Lower Miocene age in Florida. It differs by its more oblique umbos and proportionately higher shell. The pustules are variously developed and on some shells are more strongly developed and may also appear on some of the ribs anterior to the truncation. These more strongly scalptured shells may prove with more material to belong to another species.

Gatun Stage: Rio Betey.
Banana River.
Estrella River.

Subgenus **PAPYRIDEA,** Swainson

Cardium spinosum Meuschen, var. **Turtoni** Dall Plate 27, figure 1

Cardium (*Papyridea*) *spinosum* var. *Turtoni* Dall, 1900, Trans. Wagner Free Inst., Sci., vol. 3, pt. 5, p. 1108.

The fossil shells from Costa Rica, are referrible to this variety of *spinosum*, distinguished by having the interspaces between the ribs marked with a flat thread, between sharp grooves. This variety is also found fossil in the Chesapeake Miocene at Jackson Bluff Florida and in the Pliocene Caloosahatchie beds of the same state. It the recent fauna it is confined, according to Dall, to the eastern Atlantic, with the typical *spinosum* in the West Indies and a third variety *aspersum* Sowerby along the Pacific side.

Gatun Stage: Port Limon.

Subgenus **LAEVICARDIUM,** Swainson

Cardium serratum Linnæus Plate 27, figures 11, 12

Cardium serratum Linnæus, 1758, Syst. Nat., ed. 10, p. 680.

Cardium (*Lævicardium*) *serratum* Dall, 1900, Trans. Wagner Free Inst. Sci., vol. 3, pt. 5, p. 1110.

Cardium (*Lævicardium*) *serratum* Brown and Pilsbry, 1911, Proc Acad. Nat. Sci. Phila., vol. 63, p. 367.

Cardium (*Lævicardium*) *serratum* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 376, pl. 36, fig. 8.

Most of the fossil shells are indistinguishable from recent examples of *serratum* from the West Indies. Others shells are decidely oblique and approach in form the *C. sublineatum* Conrad of the Upper Chesapeake Miocene of eastern United States. The *C. venustum* Gabb from the Miocene of Santo Domingo is very distinct from *serratum* and characterized by its faintly flexuous outline, strong radial striæ, and in having the lower cardinal tooth large and strong.

Gatun Stage: Gatun, C. Z.
Middle Creek. C. R.
Rio Betey, C. R.

Genus **PROTOCARDIA,** Beyrich

Protocardia costaricensis, n. sp. Plate 27, figure 13

Shell small, rather thin, convex; beaks a little anterior to the middle, with high, inflated umbos; the anterior end is widely rounded, the posterior somewhat truncated; the posterior area is well differentiated and occupies the posterior one-third of the shell and is sculptured with numerous small radial threads separated by wider interspaces; these interspaces are finely sculptured with cross-threads; anterior of the posterior area the shell surface is sculptured with small radial threads which are finely beaded; on the anterior end of the shell, the beading is more irregular and is seen to be made by the concentric sculpture.

Height 18, length 21, diameter of the left valve 7 mm.

This species differs from both *P. jamaicensis* Dall from the Bowden beds of Jamaica and *P. islahispaniolæ* Maury from the Miocene of Santo Domingo by its smaller posterior area. It approaches more closely the Dominican shell but is shorter and more coarsely sculptured.

The *P. Newberryana* Gabb from Gatun is based on a large internal cast which is entirely unrecognizable.

Gatun Stage: Comadre creek.

Subgenus **LOPHOCARDIUM,** Fischer

Protocardia gurabica Maury Plate 27, figures 7-9

Protocardia gurabica Maury, 1917, Bull. Amer. Pal., vol. 5, p. 377, pl. 36, fig. 10.

Shell thin, inflated, a little longer than high and with the greatest convexity about the center of the shell; the umbos are high, prominent and wide, and project well above the hinge margin; the anterior end is well rounded into the base; the posterior end is more contracted and gaping slightly at its extremity; surface sculpture on the body of the shell, anteriorly consists of narrow, concentric wrinkles which are best developed on the anterior end but become obsolete on the middle of the shell and posteriorly; in addition the whole surface carries fine, sub-obsolete radial threads; on the posterior area, the sculpture is of heavier and coarser radial threads, lacking the concentric, except the irregular growth lines.

Height 56, length 32, diameter 20 mm.

The subgenus *Lophocardium*, of which there are two recent species along the West Coast of Mexico, differs from the true *Protocardia*, in its gaping posterior end and lack of lateral teeth as well-as in important difference in its anatomical structure. The shells are strongly convex, with high, inflated umbos and are extremily thin and fragile.

The *P. gurabica* was described by Dr. Maury from the Gurabo formation of Santo Domingo, and compared by her with the Vickburgian *P. diversa* Conrad, but it appears to me to be a typical *Lophocardium* and representing the first member of this interesting subgenus to be found in the fossil state. As her specimen is very fragmentary, I have redescribed the species from better preserved Panama and Costa Rican material. The posterior end is gaping and the internal mold shows no impression of lateral teeth along the hinge margin. It approaches closely the *L. Annettæ* Dall, dredged from 8 to 27 fathoms in the Gulf of California, except that it is proportionately longer and lacks the concentric wrinkles on its posterior area. The *L. Cumingi* Broderip, the type of the subgenus, carries between its posterior area and the general surface of the shell, a thin radial lamina or crest, extending from the umbos to the ventral margin.

The fossil shell is extremily thin. It generally occurs simply as internal molds which may still retains a part of the shell or impression of its sculpture on its surface.

Gatun Stage: Gatun, and Mt. Hope, C. Z.
Water Cay.
Margarita Trail, C. R.

Genus **DOSINIA,** Scopoli

Section **DOSINIDEA,** Dall

Dosinia acetabulum Conrad Plate 31, figure 1

Artemis acetabulum Conrad, 1833, Fossils of the Tertiary Formations, p. 20, pl. 6, fig. 1.

Dosinia acetabulum Bose, 1906, Boll. de Inst. Geol. de Mexico, numero 22, p. 81, pl. 11, figs. 7, 11.

Dosinia (*Artemis*) cf. *acetabulum* Toula, 1908, Jahrb. der K-K, Geol. Reichsanstalt, Wien, vol. 58, p. 727, pl. 27, figs. 8, 8a.

The *Dosinia acetabulum* has been recorded by Bose from Mexico and by Toula from Panama, but their determinations were based on imperfect material or casts. The Costa Rican collection however contains a large series of finely preserved Dosinias which are unquestionably the *Dosinia acetabulum* Conrad of the Chesapeake Miocene.

The surface of the Costa Rican specimens are generally neatly sculptured with even, concentric bands or ribbons which on the middle of the shell disk average 2 mm in width. The form of the shell is subcircular and like the typical *D. acetabulum* of the Yorktown formation of Virginia and North Carolina. The Costa Rican shells are equally as large as the Chesapeake shell measuring in height 70 mm or more.

The *Dosinia acetabulum* in the eastern United States, is a most characteristic fossil of the Chesapeake Miocene, where its range extends throughout most of the lower and upper Chesapeake formations. It is lacking from the Lower Miocene or the Alum Bluff formation of Florida, as well as from the succeeding Pliocene. In its range through the Chesakeake Miocene, it gives rise to several well-marked varieties of which the broad subcircular shell of the Upper Chesapeake is the typical form. The Costa Rican shells are most like the Upper Chesapeake typical *acetabulum*.

Brown and Pilsbry have described a smaller and more finely sculptured species from the Gatun Spillway as *delicatissima*. This spceies is represented in our collection from the same place and appears to be distinct. Toula's specimen from Gatun, however, is a true *acetabulum*.

The *Dosinia acetabulum* is a common fossil in the Gatun beds of Costa Rica, where it occurs most abundautly in the lower part of the formation.

Gatun Stage: Gatun, C. Z.
Hotel and Hone Creek.
Pumbri Creek.
Hill No. 3, Banana River.
Coll. 6, *Estrella River.*

Genus **CLEMENTIA,** Gray

Clementia dariena Conrad Plate 31, figure 4

Meretrix dariena Conrad, 1856, Pacific R. R. Reports, vol. 5, p. 328, pl. 6, fig. 55.

Clementia dariena Gabb, 1881, Journ. Nat. Sci. Phila., vol. 8, p, 344, pl. 44. fig. 16.

Clementia dariena Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1235.

Clementia dariena Toula, 1908, Jahrb. der K-K. Geol. Reichsanstalt, vol. 58, p. 725, pl. 27, figs. 9, 10.

Clementia dariena Hubbard, 1920, Scientific Survey of P. R. and the Virgin Islands, vol. 3, pt. 2, p. 118, pl. 19, figs 10-12.

This species is very common in the lower Gatun of the Canal Zone. It is very rare in western Panama and in Costa Rica, where it occurs in the lower part of the Gatun formation and in the Uscari shales. Romanes* has recorded it from Barranca near Punta Arenas on the Pacific coast of Costa Rica, from beds probably equivalent to the Lower Gatun or to the Uscari.

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* Quart. Journ. Geol. Soc. London, 1912, vol. 68, p. 125.

The shell is very thin and fragile, and hence the specimens are very frequently much crushed and distorted in shape. Typically the shell is broad and high, the beaks anterior in position and the surface sculptured with narrow, wave-like undulations which are best developed on the umbos.

Length 70, height 60. diameter 34 mm (Sousi Creek).

Uscari Stage: Sapote, C. Z. (Gabb)
Gatun Stage: Gatun, C. Z.
Nancy's Cay, Prov. of Bocas del Toro.
Upper Hone Creek, and its tributary Sousi Creek.

Genus **GAFRARIUM**, Bolton

Section **GOULDIA**, C. B. Adams

Gafrarium limonensis, n. sp. Plate 32, figure 18

Shell small, subcircular, moderately convex, umbos inflated, beaks anterior to the middle: surface finely sculptured with even, concentric riblets, more or less cancellated by fine, radial threads which are strongest on the anterior and posterior extremities, while the concentric riblets predominate on the middle of the shell; lunule distinct, narrowly lanceolate; interior of the shell deep, the hinge of both valves with 3 cardinal teeth and an anterior lateral; ventral margin concentrically grooved but not tangentially as in *Transenella*.

Length 4.75, height 4.25, diameter of the left valve 1.50 mm.

This small *Gouldia*, is fairly abundant in the Miocene coral limestones of Port Limon, and is characterized by its small, convex shell and subcircular form. Gabb has described a small *Gouldia* from the Pliocene beds of the Limon Peninsula, but that species is more depressed, less circular and more trigonal in outline. Gabb's species may prove to be but a small form of the recent West Indien *G. cerina* C. B. Adams,

Gatun Stage; Port Limon.

Old Man Sam creek, 1 mile south of the beach.

Gafrarinm altum Dall, va. **costaricensis**, n. sp. Plate 32, figures 19, 22

cf. *Gafrarium altum* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1249, pl. 57, fig. 5,

Shell small, high, rounded trigonal, moderately convex; beaks small and pointed slightly forward, in young shell nearly central but becoming with maturity slightly anterior; anterior and posterior extremities nearly similiar and evenly rounded; surface with fine, concentric lines, most distinct and even towards the ventral margin, and with faint, radial striæ on the anterior and posterior slopes; lunule large, lanceolate, defined by an impressed line; interior of shell deep, with a concentrically grooved margin.

Length 4.85, height 4.75, diameter of right valve 1.50 mm.

The Costa Rican shells differ from the typical *altum*, described by Dall from the Oak Grove sands of Florida, in being more trigonal in form and with higher beaks. The sculpture of its surface is mainly concentric, the radials showing only as very faint striæ on the posterior and anterior extremities.

Gatun Stage: Middle creek.

Coll. 6, Estrella River.

Genus **MACROCALLISTA**, Meek

Section **CHIONELLA**, Cossmann

Macrocallista maculata Linnæus Plate 31, figures 6, 7

Venus maculata Linnæus, 1758, Syst. Nat., ed. 10, p. 686, ed. 12, p. 1132.

Cytherea dariena Conrad, 1857, Pacific R. R. Report, vol. 6, p. 72, pl. 5, fig. 21.

Callista maculata Gabb, 1881, Journ. Acad. Nat. Sci. Phila., 2nd series, vol. 8, p. 372.

Macrocallista (*Chionella*) *maculata* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1256.

Macrocallista maculata Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Plila., vol. 63, p. 370.

The *Macrocallista maculata* is a common and widely distributed fossil in the Costa Rican Miocene and is readily recognized by its depressed, porcellaneous and highly polished shell. In the usual sandy phases of the Gatun, the species is quite typical, but becomes high and broad in the coralline or transitional phase.

A variety *cuneata* has been proposed by Gabb to include shells in which this posterior-dorsal slope is straight and not *humped* as usual. We have seen no examples of this type.

The *Macrocallista maculata* is a common recent species of the West Indies, appearing for the first time, in the lower Miocene beds of the Chipola River, Florida.

Gatun Stage: Headwaters of Middle creek.
Rio Blanco.

Genus **CALLOCARDIA,** A. Adams

Subgenus **AGRIOPOMA,** Dall

Callocardia gatunensis Dall Plate 32, figure 1

Callocardia (*Agriopoma*) *gatunensis* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1260, pl. 54, fig. 1.

Callocardia (*Agriopoma*) *gatunensis* Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 370.

A convex, cordate shell very abundant in the Gatun beds of the Canal Zone, especially in the quarries at Mt. Hope. It is a rare species in Costa Rica, but generally larger, more triangular in outline and somewhat coarsely sculptured. These shells are nearest to Dall's variety *multifilosa*.

Dall also records the species from the Miocene of Santo Domingo and Jamaica.

Gabb's *C. sapotensis*, from Sapote, Costa Rica, we have not seen. It is a higher and more Dosinoid shell with nearly central beaks. It is possibly but a variety of this species.

The following measurements are of Costa Rican examples:

Length 46, height 28, thickness 35 mm.
53, 44, 16 mm (right valve)

Gatun Stage: Gatun and Mt. Hope, C. Z.
Hill No. 1, Banana River.
Sousi Creek (Upper Hone creek).

Genus **PITARIA**, Roemer

Section **LAMELLICONCHA**, Dall

Pitaria circinata Born Plate 31 figures 3, 9

Venus circinata Born, 1780, Test. Mus. Vind. p. 61, pl. 4, fig. 8.

Cytherea alternata Broderip, 1835, Proc. Zool. Soc., p. 45.

Cytherea juncea Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p. 682, pl. 26. fig. 13.

Chione circinata Gabb, 1873, Tarns. Amer. Phil. Soc., vol. 15, p. 250.

Cytherea juncea Guppy, 1876, Quart. Journ. Geol. Soc. London, vol. 32, p. 531.

Pitaria (Lamelliconcha) circinata Dall, 1903, Trans, Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1269.

Pitaria circinata Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila. vol. 63, p. 370.

Pitaria (Lamelliconcha) circinata Maury, 1917, Bull. Amer. Pal., vol. 5, p. 379, pl. 37, fig. 1.

The *Pitaria circinata* Born is a common, recent Veneroid along the Caribbean coast of Panama and Costa Rica. It occurs also on the west or Pacific side but in a slightly different form, as the variety *alternata* Broderip. This variety differs from the typical *circinata* by its larger, more convex shell and more distant concentric ribs.

The fossil shells from Costa Rica are generally more like the West Coast *alternata*, but are smaller and with somewhat more pointed beaks. The species is also found as fossil, in Santo Domingo, Trinidad and Venezuela.

Gatun Stage: Gatun, C. Z.
Zone E. Saury Creek, C. R.

Pitaria Hillii Dall, var. **musanica**, n. var, Plate 31, figure 5

Shell elongate, moderately convex and rather solid; beaks situated at the anterior ⅓, with the anterior extremity widely rounded but obtusely pointed posteriorly; lunule small, ridged in the middle and defined by a faint line; posterior-dorsal area broad and flat; surface of the shell sculptured with low, irregular, rounded, concentric ribs, which are persistent along the posterior-dorsal slope but lacking elsewhere near the ventral margin; interior of shell unknown.

Length 42, height 27, thickness (left valve) 10.50 mm.

This species has a solid shell like that of *Macrocallista*. It differs from the true *Hillii* described by Dall from the Gatun of the Canal Zone, by its more rude and irregular concentric sculpture.

The *P. planivieta* Guppy, from the Miocene of Jamaica and Santo Domingo is a much shorter and more regularly sculptured shell.

Gatun Stage: Hill No. 2, Banana River, C. R.

Pitaria Guppyana Gabb Plate 31, figure 11

Caryatis Guppyana Gabb, 1881, Journ. Acad. Nat. Sci. Phila., 2nd series, vol. 8, p. 373, pl. 47, fig. 73.

Shell small, ovate, moderately convex and porcellaneous; dorsal side straight; ventral side gently convex; posterior extremity sub-truncate but wide, meeting the dorsal side nearly at right angles; anterior extremity much narrower, produced and rounded; lunule narrowly lanceolate, sculptured with the continuation of the concentric ribs and separated from the shell disk by an impressed line; surface of disk sculptured with rather wide, low or appressed ribs formed between incised lines, but the shell as a whole is porcellaneous and smooth; as the ribs pass over the dorsal-posterior area towards the dorsal margin they decrease in number through fusion; interior concealed in a hard matrix.

Length 32, height 18, diameter (right valve) 5 mm.

A small species of the coralline limestones and marls of the Limon Peninsula, from which it was described by Gabb. It approaches the *P. planivieta* Guppy of the Miocene of Jamaica and Santo Domingo but is smaller and more rectangular in outlines. It is rather convex with a smooth and polished surface and with regular, even, concentric ribs.

Gatun Stage: Port Limon.

Pitaria VanWinkleæ, n. sp. Plate 32, figure 2, 3

Shell elongate, depressed; anterior extremity broadly rounded, posterior more acute; lunule small, lanceolate and defined by an impressed line ; escutcheon long and very narrow; surface sculptured with narrow, closely spaced and reflected ribs; these ribs which number about 100 on the shell disk are even on the center of the shell, but generally uneven on the anterior extremity; the ribs are continuous from the edge of the escutcheon to the anterior dorsal margin; the rounded posterior dorsal slope carries two small, faint rows along which the concentric ribs are slightly higher and occasionally raised into small incipient spines.

Length 41.5, height 32, diameter (left valve) 10 mm.

This species is quite similiar to the *P. rosea* Broderip and Sowerby of the West Coast in its depressed shell and general form. The concentric ribs are very regular, even and continuous across the entire surface of the shell. Where these ribs cross the posterior-dorsal slope, they occasionally become raised into two rows of incipient spines. In *P. rosea* there is only one row of incipient spines and the dorsal-posterior area is smooth.

This species is named for Miss Katherine VanWinkle of the Paleontological Department of Cornell University and who is at present engaged on a Monograph of the American species of *Veneridæ*.

Gatun Stage: Hill No. 3. Banana River, C. R.

Pitaria boucaryensis, n. sp. Plate 31, figure 10

Shell rounded quadrate, thin and moderately convex; posterior and anterior extremities rounded, umbos rather large; lunule small and feebly defined by a faint, impressed line; surface of disk sculptured with about 40 even, distant, concentric lamellæ; interspaces generally smooth or irregularly sculptured with growth lines; interior of shell concealed.

Length 31, height 22, diameter (right valve) 10 mm.

As the single type specimen is fragmentary and imbedded in a hard sandstone, the above measurements are but approximate. It is a very distinctive species, differing from the other fossil Costa Rican Pitarias by its more delicate and convex shell and more distant, even, concentric lamellæ.

Gatun Stage: Boucary creek, C. R.

Genus **ANTIGONA**, Schumacher

Antigona multicostata Sowerby Plate 30, figure 1

Venus multicostata Sowerby, 1835, Proc. Zool. Soc., p. 22.
Venus multicostata Reeve, 1863, Conch. Icon., vol. 11, pl. 3, fig. 9.
Cytherea (*Cytherea*) *multicostata* Dall, 1902, Proc. U. S. Nat. Mus., vol. 26, p. 390.

This is a large species living on the south or Pacific side of the Isthmus. A perfect specimen was collected from the Gatun beds of Water Cay, identical in every respect with recent examples from the Bay of Panama. It is another instance among the many which we have had occasion to note in the course of the present study of the occurrence of West Coast species in the Caribbean Miocene, proving conclusively from a purely paleontological standpoint the rather late separation of the Atlantic and Pacific through the final uplift of the isthmian lands.

The recent *A. Listeri* Gray is a smaller, more elongate species and with finer and sharper concentric lamellæ.

Length 107 mm, height 102 mm, diameter 69 mm.

Gatun Stage: Water Cay.

Antigona tarquina Dall Plate 30, figure 10

Venus magnifica Gabb, 1673, Trans. Amer. Phil. Soc., vol. 15, p. 249. Not of Sowerby, 1853.

Cytherea tarquina Dall, 1900, Trans. Wagner Free Inst., vol. 3, pt. 5, pl. 38, figs. 2, 2a; vol. 3, pt. 6, p. 1274.

Antigona tarquina Dall, 1915, Bull. 90, U. S. Nat. Mus., p. 147.

Antigona tarquina Maury, 1917, Bull. Amer. Pal., vol. 5, p. 381. pl. 37, fig. 4.

A small shell identical or closely related to *A. tarquina* Dall was collected from Zone 3 of Saury Creek. It is similiar to Dr. Maury's specimen of *A. tarquina* from Santo Domingo.

Typical *A. tarquina* Dall is a common fossil of the *Orthaulax pugnax* fauna of the Tampa Silex beds of Florida. It was also collected by Professor Gabb and Dr. Maury from the Miocene of Santo Domingo.

Gatun Stage: Zone E, Saury creek, near Cahuita, C. R.

Section **VENTRICOLA**, Roemer

Antigona rugosa Gmeiln Plate 30, figure 4

Venus rugosa Gmelin, 1792, Syst. Nat., p. 3276.

Venus rugosa Reeve, 1863, Conch. Icon., vol. 11, pl. 7, fig. 23.

Several specimens from the coralline limestones of Port Limon. They are practically identical with recent examples of *A. rugosa* from the West Indies. This species is distributed throughout the West Indies but is also found living in the Gulf of California. This distribution on both sides of the Isthmus is in harmony with its occurrence as a Miocene fossil.

Gatun Stage: Port Limon.

Antigona Blandiana Guppy Plate 30, figures 5, 6

Venus Blandiana Guppy, 1874, Geol. Mag., London, Decade ii, vol. 1, p. 436, pl. 17, fig. 6.

Cytherea (*Ventricola*) *Blandiana* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1277.

Antigona (*Ventricola*) *Blandiana* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 381, pl. 37, fig. 5.

This species was described by Guppy from the Bowden beds of Jamaica but also collected by the Maury expedition in the Miocene of Santo Domingo. Dall also records it from the lower Miocene of the Chipola beds and from Curacoa, Dutch West Indies. It is a small species of nearly circular outlines and sculptured with distant primary lamellæ and finer secondary threads in the interspaces.

Our Costa Rican shells consist of two specimens, one from the coral limestones near Port Limon, the other from the lower Gatun of Comadre Creek near Cahuita. They differ from Dr. Maury's specimens from Santo Domingo in having the primary set of lamellæ more distantly spaced and their interspaces more closely striated with the secondary threads.

Length 30, height 24, diameter 9 mm (left valves) Comadre.

Length 24, height 23, diameter 8.5 mm (left valve) Port Limon.

Gatun Stage: Comadre creek, near Cahuita.
Port Limon.

Antigona Harrisiana, n. sp. Plate 30, figure 3

Shell small, convex and nearly circular in outline; umbos full with the beaks situated a short distance in front of the middle; lunule small but broadly cordate and sculptured with the continuation of the concentric ribs and lamellæ; escutcheon lanceolate, bordered by an angled ridge from the shell disk; disk sculptured with about 28 even, concentric ribs which appear as close undulations of the shell surface; the ribs and interspaces are in addition sculptured with fine lamellæ-like threads, each finely crenulated or radially striated; these lamellæ vary in size, those of the interspaces or troughs between the ribs are fine and 5 in number, with 2 large ones forming the tops of the ribs themselves, so that the ribs appear as if mesially divided; the radially striated character of the ribs and lamellæ is much stronger on the anterior and posterior submargins; interior of the shell deep but concealed by matrix in the type specimens.

Length 21.5, height 19.5, diameter 6.25 mm (right valve).

This elegant species occurs in the coralline phase of the Gatun formation in Costa Rica. Its relations are with the *A. Blandiana* Guppy and the recent *A. strigillina* Dall, but differs from both in its more elegant sculpture. This sculpture consists of close, regular, wave-like undulations or ribs, the crests of which carry 2, low laminæ, the troughs or interspaces, 5 or 6 finer threads. These fine thread-like laminæ are delicately etched with fine radial striations.

It is named for Professor G. D. Harris of the Paleontological Department of Cornell University.

Gatun Stage: Port Limon.

Genus **CYCLINELLA**, Dall

Cyclinella beteyensis, n. sp. Plate 31, figure 2

Shell thin, Dosinoid or sub-circular in form, the margins of the shell nearly a perfect circle; slightly convex; beaks small but distinct, situated at the anterior ⅓ of the shell ; sculpture with very fine, concentric threads, which are a little elevated and strongest on the anterior end, nearly smooth on the middle; lunule small, lanceolate and defined by a small, incised line; hinge normal, the left valve with 3, narrow; cardinal teeth and a wide ligament.

Height 39, length 38? diameter 5 mm left valve.

Represented by a single, imperfect specimen from the Gatun of Rio Betey. It is but slightly convex, and in form approaches very closely a species in the Newcomb collection from the Bay of Fonseca, which is probably the *C. Kroyeri* Philippi. The fossil shell is more perfectly circular in form.

Gatun Stage: Rio Betey.

Cyclinella subquadrata Hanley, var. **quitana**, n. sp. Plate 31, fig. 8

Shell small, thin, convex and subcircular in form; beaks small but distinct, with inflated umbo and small beak situated at the anterior ⅓; the anterior end is narrow and slightly produced, while the posterior end is wide and with the hinge-margin is subquadrate in form; the surface is sculptured with fine, irregular, concentric growth-lines, which are strongest and more regular on the posterior dorsal submargin; the interior is concealed.

Height 28, length 31, diameter of the right valve 7 mm.

This is a smaller and more convex species than the *beteyensis* and like that species, it seems to find its recent analogue on the Pacific side, in this case the *C. subquadrata* Hanley. On the Pearl Islands in the Bay of Panama I collected a few small valves which are probably the *C. subquadrata* Hanley, but they are not so produced anteriorly as is shown in Reeve's figure. These Pearl Island shells are very similiar to the Costa Rican fossil, differing mainly in their more inflated umbos and in slight difference in form.

From the Gatun beds of the Canal Zone, Dall has described *C. gatunensis*, but that species is very distinct from the two Costa Rican Cyclinellas.

Gatun Stage; Quitana creek.

Genus CHIONE, Megerle von Mühlfeld

Chione Rowleei, n. sp. Plate 30, figure 2

Shell rather large, convex, ovate; lunule broadly cordate and concentrically sculptured; escutcheon long, narrow, smooth and defined by a small cord-like ridge; surface of the disk with about 30 slightly elevated concentric ribs which on the umbos are thin and lamellar but lower on the shell disk are wide and trianglar at the base, but with a thin zigzag or fluted lamellar ridge on top; the interspaces, much wider on the umbos is sculptured with even rib-like cords which also flute in harmony the dorsal face of the concentric ribs; the ventral face of the ribs are finely striated by radial incised lines which form cord-like ridges along ½ as wide as the radial cord of the interspaces; interior of the shell deep, with a small pallial sinus and subequal adductor scars; basal margin finely crenulated as well as the lunular margin and the extreme posterior extremity.

Length 42, height 37.5, thickness (right valve) 17 mm.

This large, elegant *Chione* is quite common in the Gatun beds of Costa Rica. It also occurs in the lower Gatun at Gatun, usually in the form of casts. It recalls in a general way, the recent West Coast *C. amathusia* Philippi, but differs in its heavier shell, higher and fuller umbos and difference in details of its spiral and radial sculpture. In the Costa Rican shell, the radial cords are simple, relating it more closely with the small *C. Woodwardi* Guppy of the Miocene of Jamica and Santo Domingo, while in *C. amathusia*, they are double and alternating.

The *C. tegulum* Brown and Pilsbry we have not seen. It is a smaller shell, related to the *C. Woodwardi*. In *C. tegulum* the concentric lamellæ are much closer and the wide cordate lunule is sculptured only with radial lamellæ.

It is named for Professor W. W. Rowlee, who collected a few specimens from the Banana River in the course of botanical investigation of the Balsa tree (Genus *Ochroma*), a very light wood used in the construction of life-buoys, etc.

Gatun Stage: Gatun, C. Z.
Banana River.
Coll. 6, Estrella River.

Chione costaricensis, n. sp. Plate 32, figure 4

Shell of moderate size, convex, ovate-trigonal; the dorsal portion of the type specimen is lacking; the surface is sculptured with fine, subregular, concentric lamellæ spaced on the center of the shell disk about .75 mm apart; the interspaces and the ventral surfaces of the lamellæ are marked with regular, incised lines forming radial bands of an average width of .40 mm; a faint radial sinus extends from the beaks to the posterior; ventral margin of the shell is slightly arcuate at its posterior end; interior of ventral margin finely crenulated.

Length 34, height 29, diameter of the right valve 10 mm.

This shell will be distinguished from the other Costa Rican Chiones by its more crowded, concentric, lamellæ and regular, radial striæ. The striæ occur on the ventral faces of the lamellæ and on their interspaces.

Gatun Stage: Hill No. 3, Banana River.

Section **LIROPHORA**, Conrad

Chione mactropsis Conrad Plate 30, figures 7, 8

Gratelupia? mactropsis Conrad, 1856, Pacific R. R. Reports, vol. 5, p. 328, pl. 6, fig. 54.

Chione (*Lirophora*) *mactropsis* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1294.

Chione (*Lirophora*) *mactropsis* Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p, 369.

Chione (*Lirophora*) *ulocyma* Brown and Pilsbry, 1911, *Idem*, p. 369. Not of Dell. 1903.

Until the construction work on the Panama Canal had commenced in earnest, the abundant and finely preserved fossils of the Canal Zone, so easily obtained at the present time, were not available, and the only fossil remains collected by the early travellers were generally in the form of poorly preserved casts. In 1856 there appeared in the Pacific Rail Road Reports, the description of an internal cast as *Gratelupia? mactropsis*, together with scarsely recognizable *Turritella gatunensis* and *altilira.*

These specimens obtained by Mr. W. P. Blake from the Isthmus are the first noticed from the fossiliferous rocks in Panama and Central America.

The *Lirophora mactropsis* described by Conrad from an internal cast as *Gratelupia ?*, is one of the most abundant fossils in the Gatun beds of the Canal Zone, associated with the smaller and more finely sculptured *holocyma* Brown and Pilsbry. *L. mactropsis* is a species of variable size, but moderately convex, longer posteriorly and usually with the basal margin more or less arcuated about the posterior extremity. The sculpture consists of irregular, more or less confluent concentric lamellæ, which are overrun by fine radial lines. These radial lines may remain strong or become obsolete as usual with specimens from the Canal Zone. A narrow foliaceous band is developed on each side of the escutcheon and another about the anterior extremity below the lunule. The Costa Rican examples are often very much larger than those of the Canal Zone, the concentric lamellæ are finer and less confluent and with more persistent radial lines. The following measurements will illustrate the range in size:

Length 30, heigth 23, thickness 15 mm, Central Zone.
37, 28, 19 " "
41.5, 32, 9.5 mm (right valve) Old Man Sam Creek, C. R.
51.5, 38, 21.5 mm, Sousi, C. R.

Gatun Stage: Gatun, and Mt. Hope, C. Z.
Old Man Sam creek, C. R.
Sousi creek (Upper Hone creek)
Banana River.

Chione holocyma Brown and Pilsbry Plate 30, figure 9

Chione ulocyma Dall, variety *holocyma* Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 369.

Associated with *mactropsis*, in the Central Zone is a more convex and finely sculptured shell, allied to the *ulocyma* Dall of of the Floridian Miocene. It is the *holocyma* of Brown and Pilsbry. We have seen no typical *ulocyma* from Panama.

From *mactropsis*, the *holocyma* will be distinguished by its generally smaller, more convex and more circular shell. Its concentric lamellæ are more numerous and less confluent and with fine but persistent radial striæ. It is generally best distinguished by its smaller and less clearly differentated foliaceous area on its anterior extremity, which in *mactropsis* is as wide an area as that along its posterior dorsal margin.

Heigth 29, length 36.5, thickness 19 mm.

Gatun Stage: Mt. Hope, C. Z.

Chione hotelensis, n. sp. Plate 32, figure 7

Shell small, subtrigonal, heavy, but slightly convex; sculpture of about 15, thick, rounded and evenly spaced concentric lamellæ; on the posterior-dorsal slope, the ends of the lamellæ become attenuated, thin and somewhat appressed as in *glyptocyma* Dall of the Flordian Miocene; the lamellæ themselves are smooth and rounded but with their interspaces finely radially incised by small lines; escutcheon rather large, smooth; lunule small, cordate and smooth except for the growth lines,

Length 23, height 19, thickness 12.5 mm.

This elegant little species is distantly related to the *C. glyptocyma* Dall from the Oak Grove sands of Florida, but is a smaller and more compact shell. The radial striations commence on the ventral surface of the lamellæ and are continued across the interspace to the base of the next rib.

All of our specimens were collected in a hard sandstone in the lower Gatun of Hotel Creek near Old Harbor, Costa Rica.

Uscari Stage: Hotel creek, C. R.

Chione chiriquiensis, n. sp. Plate 32, figure 9, 10

Shell small, solid, depressed; lunule rather large, cordate, smooth; escutcheon large, smooth and defined by an angled ridge; surface of the disk sculptured with about 8, large, irregular ribs, like those of *Chione latilirata*; these ribs do not extend to the edge of the escutcheon, but commence a short distance in front leaving a narrow band which is smooth and sculptureless; the ribs are of variable size, flat-topped and smooth; they are rounded on their ventral side, but shelving or recurved backwards on the dorsal face; interspaces smooth or only sculptured with fine growth-lines; interior of shell of moderate depth, with a small pallial sinus and with a slightly larger posterior adductor scar; basal margin finely crenulated.

Length 13.75, height 12.50, diameter 9.50 mm.

The few specimens which we have from Water Cay, are probably immature, but they possess such distinctive characters that the species cannot be mistaken.

The heavy, irregular concentric ribs recall certain varieties of *Chione latilirata* Conrad. They differ in being abruptly cut off or flattened a short distance behind the dorsal-posterior angle leaving a band as in *C. paphia* Linnæus, but smooth and sculptureless. The interspaces are smooth.

Gatun Stage: Water Cay.

Section **TIMOCLEA**, Brown

Chione grus Holmes, var. Plate 26, figure 21

Tapes grus Holmes, 1858, Post-Pliocene Fossils of S. Car., p. 37, pl. 7 fig. 5.

Chione (*Timoclea*) *grus* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1299.

We have but a single and not entirely perfect specimen of a *Timoclea* closely related to *C. grus* Holmes. It is somewhat more convex than typical *C. grus* from the Carolinas and more finely sculptured. More material is needed to show whether or not these charaters are constant. The *C. grus* appears as a fossil in the Upper Chesapeake Miocene of the eastern United States and is recent from Cape Hatteras to Yucatan.

Gatun Stage: Coll. 4, Red Cliff creek.

Genus **TELLINA,** (Linné) Lamarck

Tellina rovala, n. sp. Plate 26, figures 7, 8

Shell elongate, slender, subequilateral with the beaks situated near the center of the shell; anterior side long, with a straight dorsal margin and narrowly rounded at its extremity; posterior side much narrowed and rostrate, the left valve with 2 radial bands forming the rostrum, the dorsal one a fold, the other a wide sinus; ventral margin rounded anteriorly, nearly straight about the middle and a wide sinus posteriorly; the surface is sculptured with even, concentric lamellæ; this sculpture on the rostrum is heavier and on crossing the fold and sinus become reversed in position.

Length	height	semi-diameter
29,	12,	2.5 mm.
36 ?	14	3 mm.

We have two specimens of this typical *Tellina* from Water Cay. The larger specimen is fragmentary but probably measured when complete about 36 mm in length. The species recalls the recent West Indian *T. interrupta* Wood (*T. antonii* Philippi) in its form and sculpture but lacks the finer radiating striæ.

Gatun Stage: Water Cay.

Subgenus **ARCOPAGIA,** (Teach)

Section **MERISCA,** Dall

Tellina crystallina Wood Plate 26, figure 10

Tellina crystallina Wood, 1815, General Conchology.

Tellina (*Merisca*) *crystallina* Dall, 1901, Proc. U. S. Nat. Mus., vol. 23, p. 311, pl. 2, fig. 10.

Tellina (*Merisca*) *crystallina* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 387, pl. 38, fig. 4.

This *Tellina*, the type of the section *Merisca*, is recognized by its thin, depressed shell, strongly sculptured with distant, but regular, raised, concentric lamellæ. It is very rare as a fossil, our collection containing but a single specimen from the Gatun beds of the Banana River. It has previously been recorded by Maury as a Miocene fossil in Santo Domingo.

In the recent fauna, *Tellina crystallina* is distributed along both the Atlantic and Pacific coasts of Central America. I have collected a few specimens from the beaches of Bocas Island and more abundantly at Bucaru, Province of Los Santos, on the Pacific side of Panama.

Gatun Stage: Hill No. 2. Banana River.

Tellina nasua, n. sp. Plate 26, figure 17

Shell sub-rhomboid, slightly convex, thin; beaks small, inconspicuous, posterior to the middle; the anterior end longer, the dorsal-anterior dorsal margin descending, the extremity rounded into the gentle curve of the base; (the posterior side broken in the type specimen); the greatest convexity of the shell lies along the broad, umbonal slope anterior to the beaks; the surface is finely sculptured with regular, sharp, concentric ridges, separated by narrow, band-like interspaces; interior of the right valve with a large pallial sinus which extends to the anterior ¼ of the shell; hinge appearing normal for the section, but partly broken away, but showing a large anterior lateral tooth.

Length 20 ? Height 15.25, diameter of the right valve 3.00 mm.

Our specimen if fragmentary, the posterior portion of the shell being broken away. There is however little doubt that the species is a true *Merisca*, allied to *T. æquistriata* Say and

T. lintea Conrad. It differs from *æquistriata* in its greater dorsal anterior slope and finer sculpture, and from *T. lintea* of the recent fauna, in its somewhat greater proportional height and greater convexity.

Gatun Stage: Coll. 4, Red Cliff creek.

Section **PHYLLODINA,** Dall

Tellina lepidota Dall Plate 26, figures 4, 5

Tellina (*Phyllodina*) *lepidota* Dall, 1900, Trans. Wagner Free Inst. Sci., vol. 3, pt. 5, p. 1022, pl. 46, fig. 18.

Dall's type of this species is based on a fragmentary right valve from Gatun. We have several complete and large specimens from Water Cay, where the species is fairly common. The right valve is flat and depressed, the left more convex. Both valves are nearly similarly sculptured with 2 or 3 wide undulations of the beaks, which are soon replaced by even, sharp, concentric lamellæ, of which 3 or 4 are higher and more lamellose on the dorsal margin.

Length 24, height 12.5, diameter of the left valve 2.75 mm.

Length 21.5, height 11.00, diameter of the right valve 1.25 mm.

Gatun Stage: Water Cay.

Section **EURYTELLINA,** Fischer

Tellina costaricana, n. sp. Plate 26, figures 6, 9

Shell oblong, depressed; beaks small and inconspicuous about the middle of the shell so that the anterior and posterior ends are of nearly the same length; posterior end widely rounded the anterior but slightly narrowed and less rounded at its extremity; anterior and posterior dorsal margins nearly straight; surface of the disk finely sculptured with even, concentric lines which are slightly lamellose on the posterior-dorsal margin; interior concealed.

Length 32, height 19, semi-diameter 2 mm.

This species is related to the recent West Indian *T. angulosa* Gmelin and its Pacific analogue, the *T. rubescens* Hanley. The fossil shell differs by its more central beaks and sharper concentric sculpture, which is continued across the entire surface of the disk.

Gatun Stage: Hill No. 3, Banana River.

Tellina dariena Conrad Plate 26, figure 3

Tellina dariena Conrad, 1857, Pacific R. R. Reports, vol. 5, p. 328, pl. 6, fig. 53.

Tellina semilævis Gabb, 1861, Proc. Acad. Nat. Sci. Phila., vol. 12, p. 567.

Tellina Dariena Gabb, 1881, Journ. Acad. Nat. Sci. Pnila., vol. 8, p. 343, pl. 44 fig. 13.

Tellina Rowlandi Toula, 1908, Jahrb. der K-K. Geol. Reichsanstalt vol. 58, p. 728, pl. 28, fig. 11.

Tellina Rowlandi Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 368.

Conrad's figure of *Tellina dariena* is very poor but probably represents this species, the most abundant *Tellina* at Gatun. Conrad's figure shows a subtrigonal shell, with a produced and truncated posterior extremity. In 1861, Gabb described *Tellina semilævis* together with *Arca chiriquiensis* from the Gatun beds of the Chiriqui Lagoon. This species Gabb however later considered synonymous with the earlier *Tellina dariena* of Conrad. Toula's *Tellina Rowlandi* is certainly identical with Gabb's *Tellina semilævis* as figured by Gabb.

Shell but slightly convex, subequilateral with the beaks situated a short distance posterior to the middle of the shell; anterior and posterior dorsal slopes straight and evenly descending; posterior end rounded and subtruncate, the anterior rounded; beaks low; surface striated with very fine concentric lines and the shell may sometimes appear nearly smooth and polished especially on the umbonal areas; hinge of the left valve with a bifid anterior cardinal, a small posterior and 2 laterals; the anterior adductor is bordered on the posterior side by a thickened internal ray; pallial sinus long, ascending above in the middle of the shell and touching the anterior adductor scar.

Length 34, height 19.5, semi-diameter 3.50 mm.

Gatun Stage: Gatun, C. Z.
Water Cay.
Chiriqui Lagoon and Oronli creek (Gabb)

Subgenus **ANGULUS,** Mergerle

Section **ANGULUS**, s. s.

Tellina umbra Dall Plate 26 figures 12, 15

Tellina (*Angulus*) *umbra* Dall, 1900, Trans. Wagner Free Inst. Sci., vol. 3, pt. 5, p. 1033, pl. 46, fig. 13.

The Costa Rican specimen consists of a small individual with both valves. It is somewhat smaller than typical *umbra*, from the Upper Chesapeake Miocene of the Carolinas, but agrees in form and in the fine surfrce sculpturing.

The *Tellina umbra* is a common fossil in the Upper Chesapeake Miocene of the eastern United States and in the Pliocene of Florida. It is closely allied to the recent *Tellina sybaritica* Dall of the West Indies, differing most importantly in its less angular posterior extremity.

The Costa Rica specimens measures:

Length 8.00, height 4.15, diameter 2.25 mm.

Gatun Stage: Coll. 4, East Grape Point creek.

Section **SCISSULA,** Dall

Tellina cercadica Maury

Tellina (*Scissula*) *cercadica* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 388, pl. 38, fig. 9.

The Costa Rican specimens are fragmentary but there can be little doubt of their identity with the *Tellina cercadica* Maury from the Miocene of Santo Domingo.

The shell is thin and strongly depressed. The surface is polished and obliquely striated with fine lines. It is related to the recent Pacific *Tellina delicatula* Deshayes.

Gatun Stage: Coll. G, Saury creek.
Estrella River.

Genus **TELLIDORA**, Moerch

Tellidora cristata Recluz Plate 26, figurce 1, 2

Lucina cristata Recluz, 1742, Revue Cuvier., p. 270.

Tellidora cristata Dall, 1900, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 1037.

A recent species of the West Indies and previously known as a Pliocene and Pleistocene fossil from Carolinas. The fossil Costa Rican shells are frequently larger than the recent form and with the dorsal margins more nearly in line. It is not rare in the form of impressions but the perfect shell is seldom found.

Gatun Stage: Hills 1a, 2 and 3, Banana River.

Genus **STRIGILLA**, Turton

Strigilla pisiformis Linné

Tellina pisiformis Linné, 1758, Syst. Nat., ed. 10, p. 677.

Strigilla pisiformis Dall, 1900, Trans. Wagner Free Inst. Sci., vol, 3, pt. 5, p. 1038.

Strigilla pisiformis Maury, 1917, Bull. Amer. Pal., vol. 5, p. 389, pl. 39, fig. 6.

This species is rare as a fossil in Costa Rica. It is very common as a recent shell on the sandy beaches along the entire north coast of both Panama and Costa Rica, where it occurs with *Donax denticulata* Linné and a few other species. It is also found as a Miocene fossil in the Bowden beds of Jamaica and in Santo Domingo.

Gatun Stage: Middle creek.

Strigilla musanica, n. sp. Plate 26, figure 18

Shell subtrigonal, moderately convex, subequilateral; the umbos are broad and wide, situated about the middle of the shell, with the greatest convexity of the shell lying along the anterior-umbonal slope; the anterior end is broad and rounded, the posterior slightly narrow, but not produced; the sculpture is divided between three areas, the posterior, central and anterior, each of which is set off from the adjacent one, by a marked change in sculpture along a well-defined line; on the anterior area, it consists of a concentric series of wave-like incised lines, the crest of the wave lying near the posterior side and directed as usual dorsally; on the central area, the lines are vertically directed, commencing on the lines bordering the posterior side; on the posterior area, the lines commence on the anterior side and pass vertically, forming therefore with the middle lines very acute angles; the interior is concealed in our specimen.

Length 13.00, height 11.50, diameter of the right valve 3.00 mm.

Differs from *Strigilla carnaria* Linné of the recent West Indian fauna, by being more inequilateral, more convex and in details of its sculpture which is sharply divided between three areas as described. The interior of the type specimen is concealed, so that the features of the pallial line and sinus cannot be determined.

Gatun Stage: Hill No. 3, Banana River.

Genus **METIS**, H. and A. Adams

Metis barba, n. sp. Plate 29, figures 3, 4

Shell subquadrate, inequilateral, with the beaks situated at the anterior two-thirds of the total length of the shell; anterior end longer with a sloping dorsal margin and rounded anterior extremity; posterior side shorter, with a dorsal margin sloping more rapiding to the wide and flexed posterior end; the left valve is convex but depressed along the narrow posterior submargin or wing; the right valve is less convex with a broad depressed area extending from the beaks to the ventral margin; this depressed zone is sharply separated from the posterior-dorsal slope or wing by a strong angle or flexure which corresponds to the sinus in the middle of the wing on the left valve; surface finely striated with concentric growth-lines.

Length 48, height 37, diameter 19 mm.

Pilsbry and Johnson have described without figuring, two species of *Metis* from the Miocene of Santo Domingo (the *M. efferta* and *postrema*). These species, they compare with the *M. chipolana* Dall, from the Chipola beds of Florida and mention in their description the nearly central location of the beaks. In the Costa Rican shell the beaks are at the posterior one-third of the shell. It is very distinct from the *M. chipolana* Dall. *M. trinitaria* Dall from Trinidad and Porto Rico differs in its more central beaks, fuller umbos and has the right valve much less flexed posteriorly.

Gatun Stage: Betey creek.

Genus **MACOMA**, Leach

Macoma costaricana, n. sp. Plate 26, figures 14, 16

Shell broadly ovate, thin and slightly inflated; dorsal and ventral margin straight and parallel; the posterior dorsal side sloping to the rounded ventral extremity; anterior extremity rounded; the posterior side is very slightly flexed; surface smooth except for very fine, incremental growth lines; interior of shell concealed.

Length 29, height 19, semi-diameter 4.5 mm.

The reference of this species is *Macoma* is doubtful as the hinge is completely concealed in all our specimens. It has the form of the *M. Conradi* Dall, from the Chesapeake Miocene of United States but is higher and differs in many other respects. It is shorter and higher than *M. gatunensis* Toula with which it may occur.

Gatun Stage; Hill No. 3, Banana River.
Rio Betey.

Subgenus **PSAMMACOMA,** Dall

Macoma gatunensis Toula Plate 26, figure 13

Macoma (*Tellina*) *gatunensis* Toula, 1908, Jahrb. der K-K Geol. Reichsanstalt, vol. 58, p. 729, textfigure 10.

Tellina gatunensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 368.

This shell is extremely similiar to the recent *M. elongata* Hanley of the Pacific coast of Panama and I have failed to find any character which will distinguish the fossil shells from the recent ones. Our shells were all collected loose near Hill 3, of the Banana River and were probably derived from beds low in the Gatun formation.

Gatun Stage: loose, near Hill 3, Banana River (*Terry*).

Macoma panamensis Dall, var. **canalis**, n. var, Plate 26, figure 11

Cf. *Macoma* (*Psammacoma*) *panamensis* Dall, 1900, Proc. U. S. Nat. Mus., vol. 23, p. 324, pl. 4, fig. 3.

The *Macoma panamensis* Dall was described from a left valve dredged from 33 fathoms of water in Panama Bay. The fossil shell, also a left valve from the Gatun of Mt. Hope, differs most importantly from Dall's figure in being somewhat higher. The shell is thin and extremely fragile, with the surface simply scultured with the fine growth lines. The interior is concealed so that the characters of the pallial sinus cannot be seen. The specimens measures as follows:

Length 30.50, height 15.00, diameter of the left valve 3.00 mm.

Gatun Stage: Mt. Hope, C. Z.

Genus **SEMELE**, Schumacher

Semele lævis Sowerby, var. **costaricensis**, n. var. Plate 29 figure 1

Cf. *Amphidesma lævis* Sowerby, in Reeves, 1853, Conch. Icon., pl. 7, fig. 50.

Shell large, subelliptical, but slightly convex; beaks very nearly central, the posterior side wide and well rounded, the anterior somewhat narrowed, contracted and slightly the longer; the surface is nearly smooth and porcellaneous, faintly marked on the anterior and posterior extremities by fine, concentric lines.

Length 72, height 65.50, semi-diameter 8 mm.

This large *Semele* is quite common in the Lower Gatun beds of the Banana River. It is closely related to the recent Pacific *S. lævis* Sowerby, but differs in being slightly longer and more evenly rounded at its posterior extremity.

Gatun Stage: Hill No. 3, Banana River.
Hill 1a, Banana River.

Semele Sayi Toula Plate 29, figure 8

Semele Sayi Toula, 1908, Jahrb. der K-K Geol. Reichsanstalt, Wien, vol. 58, p. 730, pl. 28, fig. 17.

Semele Sayi Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila. vol. 63, p. 368.

Shell convex, rather thin, with the umbos nearly central. The anterior side is somewhat narrow or contracted, and rounded at its extremity. The surface is sculptured with fine, hair-like, concentric threads. The species was described by Toula from the Canal Zone. Our record from Costa Rica is based on a single, imperfect specimen from Sousi creek, where it occurs associated with *Clementia*, *Chione mactropsis* and *Turritella altilira* variety *costaricensis* in the lower part of the Gatun formation.

Gatun Stage: Sousi creek.

Semele Claytoni Maury Plate 29, figure 2

Semele Claytoni, Maury, 1917, Bull. Amer. Pal., vol. 5, p. 227, pl. 35, fig. 9.

The *S. Claytoni* was described by Dr. Maury from the Cercado formation, Santo Domingo of Lower Miocene age. It is a large species, reaching a length of 66 mm or more and characteristically sculptured with even, concentric lamellæ like the related species from the Tertiaries of eastern United States as *chipolana* Dall, *Leana* Dall and *perlamellosa* Heilprin. From these, the *S. Claytoni* is distinguished in having its radial striæ nearly obsolete. Our specimen from Costa Rica is fragmentary but probably measured when perfect 38 by 30 mm.

Uscari Stage: Hotel creek.

Genus **ABRA**, (Leach) Lamarck

Abra triangulata Dall Plate 29, figure 10

Abra triangulata Dall, 1900, Trans. Wagner Free Inst., Sci., vol. 3, pt. 5, p. 997, pl. 49, fig. 4.

A small, rotund or trigonal species abundant in the shale beds of Bocas Island. The valves are nearly equilateral, the anterior end slightly the larger and inflated. Surface smooth and shining. The type was described by Dall from the Bowden beds of Jamaica. Our specimens are a little larger, measuring:

Length 7.25, height 6.50, diameter of the left valve 1.75 mm.

Gatun Stage: Bocas del Toro.

Genus **PSAMMOSOLEN**, Risso

Psammosolen gatunensis Toula, var. **costaricensis**, n. var.

Plate 29, figure 7

Solecurtus gatunensis Toula, 1908, Jahrb. der K-K. Geol. Reichsanstalt, vol. 58, p. 732, pl. 28, fig. 12.

Solecurtus gatunensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 58, p. 372.

Shell rather large, elongate, convex, the dorsal and ventral margins straight and parallel; the low, inconspicuous beaks situated at the anterior ⅓, the anterior end rounded, the posterior subtruncate; two low, radial depressed rays extend from the beaks obliquely to the ventral margin; the central part of the shell and the anterior end is sculptured roughly with irregular growth lines; the posterior dorsal slope has strong, vertical or slightly oblique lines which cross the finer concentric growth lines; in addition the whole surface of the shell is roughened by small, short threads as if the surface had been painted with a stiff brush.

Length 63, height 25.50, diameter of the right valve 14.50 mm.

Toula's figure of an internal mold shows a smaller shell, a strong anterior-umbonal angle and a somewhat shorter anterior end. It is possible that the two forms are distinct but we lack a good comparative series of the Gatun shell. A smaller and more delicate species of *Psammosolen* occurs at several localities in the Costa Rican Gatun. It is not the *P. strigillatus* (*L*) of Toula, differing in its pointed anterior end.

Gatun Stage: Rio Betey.

Genus **SANGUINOLARIA**, Lamarck

Section **SAMMOTELLA**, Blainville

Sanguinolaria alouatta, n. sp. Plate 29, figures 5, 6

Shell rather large, elongate; and rostrated behind; left valve nearly flat, the right valve much more convex; the right valve carries a strong umbonal keel from the tip of the beaks to the posterior extremity; this keel is but poorly developed on the left valve; anterior end broadly rounded with the dorsal and ventral margins nearly parallel; the posterior side is much narrower and with its extremity pointed; the surface is smooth; the dorsal-posterior slope of the left valve is less smooth and carries coarse, irregular growth-lines; the interior is not known.

Length 54, height 30, semi-diameter 4 mm (a left valve)
Length 60, height 27.5 semi-diameter 7 mm (a right valve)

This species stands intermediate between the *S. Smithwoodwardi* Maury from the Miocene of Santo Domingo and the recent West Indian *S. operculata* Gmelin. It differs from the *Smithwoodwardi*, in being much larger with a less depressed left valve: From *operculata* the Costa Rican shell has higher and more pointed beaks as well as being longer posteriorly. In full-grown specimens of *operculata*, the surface generally shows radial lines and striæ which may become quite strong near the posterior ventral margin. The Costa Rican shells are smooth except for the growth lines.

Gatun Stage: Hill No. 3, Banana River.

Genus **TAGELUS**, Gray

Tagelus cebus, n. sp. Plate 29, figure 9

Shell elongate, moderately convex and solid; beaks central with the anterior and posterior ends nearly equal, and with the dorsal and ventral margins parallel and nearly straight; anterior and posterior extremities subtruncate; a broad depressed zone extends from the umbos to the ventral margin of the valves; surface marked with irregular concentric lines of growth; interior concealed.

Length 36, height 13, diameter of the left valve 3.00 mm.

The *Siliqua subæqualis* Gabb, from the Miocene of Santo Domingo is doubtless a *Tagelus*, belonging to the Section *Mesopleura* Conrad. It differs from the present shell in being thinner, more depressed and more pointed posteriorly. Gabb's species approaches very closely the recent *T. divisus* Spengler of the West Indian fauna, judging from the specimens in the Maury collection at Cornell, differing mainly in its larger size.

The interior of the Costa Rican shell is concealed so that the presence or absence of an internal rib cannot be determined. Its heavier shell and general form, is more that of typical *Tagelus* differing from the recent *gibbus* Spengler in its more central beaks.

Gatun Stage: Rio Betey.

Genus **MACTRA** (L.) Lamarck

Subgenus **MACTRELLA**, Gray

Mactra exoleta Gray Plate 28, figure 2

Mactra exoleta Gray, 1837, Mag. Nat. Hist., p. 372.
Mactra exoleta Reeve, 1854, Conch. Icon., *Mactra*, fig. 16.

Comparision of our fragmentary shell with recent examples from the Bay of Panama show no inportant differences. The species is notable for its high, narrow, inflated umbos, strongly depressed posterior-dorsal margin and alation of its dorsal-posterior angle.

At the present time, this species is restricted to the Pacific side, but represented on the Caribbean coast by the next, the *Mactra alata* Spengler, common along sandy beaches. It is therefore of more than usual interest to find these two species, together in the Miocene beds of the Caribbean slope of Costa Rica.

Gatun Stage: Boucary creek.

Mactra alata Spengler Plate 28, figure 3

Mactra alata Spengler, 1802, Skriv. Naturch. Selsk., vol. 5, part 2, p. 99.

Mactra alata Reeve, 1854, Conch. Icon., *Mactra* pl. 8, fig. 29.

Mactra (*Mactrella*) cf. *alata* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 395.

A thin, fragile species distinguished by its sharp dorsal-posterior angle and hatchet-shaped shell. It is related to the *exoleta*, already referred to, but is a very much broader shell. In *exoleta*, the dorsal-posterior area is flat or concave, with a slight raised line which is bounded on each side by a markly depressed or sunken band. In *alata* this area is convex.

It is living today on the Caribbean side of the Isthmus, being quite common on sandy beaches.

Gatun Stage: Boucary Creek.
Hill No. 3, Banana River.

Section **HARVELLA,** Gray

Mactra estrellana, n. sp. Plate 28, figure 1

Shell rather large, ovate, thin, slightly convex; surface regularly, concentrically plicated; the fragmentary type specimen about 38 mm in height has about 32 plicæ which on the center of the shell disk are spaced about 2 mm apart; these plicæ commence as in typical *Harvella* at the dorsal-posterior carina which bounds the escutcheon and extends across the surface to the anterior extremity; the surface is, in addition, finely, concentrically striated; lunule large elliptical, smooth or finely striated; escutcheon smooth; interior not known.

Length 50, height 38, semi-diameter 8 mm,

Although this is not a very rare species in the Costa Rican Miocene, its thin, delicate shell renders the collecting of good specimens very difficult and it is usually secured only as distorted internals molds. It is related to the recent Pacific *H. elegans* Sowerby, but differs in being less convex, wider and with more numerous and closer concentric plicæ.

Gatun Stage; Coll. 6. Estrella River.
Coll. 2, Quitana creek.

Mactra sincola, n. sp. Plate 28, figure 4

Shell thin, broadly subtrigonal, depressed, nearly equilateral; beaks small and pointed anteriorly; lunule absent; escutcheon linear-lanceolate and defined from the shell disk by an elevated carina; the surface is sculptured with strong, wave-like, concentric plicæ which are continuous from the anterior-dorsal margin to the edge of the escutcheon; on the type specimen there are about 30 plicæ on the center of the shell disk, spac ed about 1.75 mm apart; the intervals between the concentric plicæ are deep and trough-like and in width equal to the plicæ themselves; in addition the whole surface of the shell is finely sculptured with small, radial, vermiculate threads, best seen on the summits of the plicæ; the escutcheon is ridged on the middle and smooth; the hinge, largely concealed in the sandy matrix, is mactroid.

Length 36, height 27, diameter of the right valve 5.5 mm.

The systematic position of this interesting shell is very doubtful. Its general surface sculpture of strong, concentric plicæ and well-defined escutcheon resembles that of *Harvella*. The surface is covered with fine, vermiculate threads as seen on *Labiosa*.

Gatun Stage: Saury creek.

Genus **LABIOSA**, (Schmidt) Moller

Labiosa lineata Say Plate 21, figure 11

Lutraria lineata Say, 1821, Journ. Acad. Nat. Sci. Phila., vol. 2, p. 310.

Mactra Nuttallii Reeve, 1854, Conch., Icon., *Mactra*, fig. 125.
Labiosa lineata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 906.

This species is represented in our collection by fragments of the hinge and a perfect mold of the interior which is figured. This mold compares very closely with recent specimens of *Labiosa lineata* Say.

Dall records this species as fossil in the Pliocene Caloosahatchie beds of Florida and we have several fragments in the Cornell collection from the Upper Chesapeake Miocene of Natural Well, North Carolina.

Gatun Stage: Saury creek.
Coll. 6, Estrella River.

Genus **MULINIA**, Gray

Mulinia lateralis Say, var. **sauryensis**, n. var. Plate 28, figures 23. 24

The species of *Mulinia* are extremlly variable and we have therefore associated this form with the common *lateralis* of Say, although it may later prove to be a distinct species.

The general form of the shell is like *corbuloides* Deshayes, the common Gulf variety of *lateralis* of Say. It differs most importantly from *lateralis* in having the beaks situated a short distance above the hinge-line as is seen in the Chesapeake Miocene *M. congesta* Conrad. In other characters, the Costa Rican shells are more closely related to the *lateralis*, than to the *congesta*. The shell is fairly convex and thin.

Length 20, height 16, semi-diameter 6 mm.

Gatun Stage: Zone E, Saury creek.

Genus **MESODESMA**, Deshayes

Mesodesma costaricensis, n. sp. Plate 28, figure 18

Shell ovate, moderately convex, inequilateral, thin; anterior end about ½ again as long as the posterior, rounded; beaks high, triangular; posterior and anterior dorsal margins straight; ventral margin evenly rounded; surface nearly smooth; but with the dorsal submargins finely concentrically grooved; interior concealed.

Length 22, height 16, semi-diameter 4 mm.

A rather thin, *Donax*-like shell from the Lower Gatun beds of the Banana River. Its surface is smooth and polished with concentric grooves on its posterior and anterior dorsal area.

Gatun Stage: Hill No. 3, Banana River.

Genus **GASTROCHAENA**, (Spengler) Cuvier

Gastrochæna rotunda Dall

Gastrochæna ovata Sowerby, variety *rotunda* Dall, 1898, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 825.

Gastrochæna rotunda Dall, 1915, Bull. N. S. Nat. Mus., No. 90, p. 157, pl. 19, fig. 2.

A single, small specimen of a *Gastrochæna* was collected in the Gatun of Red Cliff Creek. It is widely expanded about the posterior portion and probably represents a young shell of *G. rotunda* which Dall records from the Bowden beds of Jamaica. This species is also found in the Tampa Silex beds and in the Lower Miocene of Florida.

Gatun Stage: Coll. 4, Red Cliff Creek.

Genus **CORBULA**, Lamarck

Section **ALOIDIS**, Megerle

? **Corbula vieta** Guppy Plate 28, figures 15, 16

Corbula vieta Guppy, Quart. Journ. Geol. Soc. London, vol. 22, p. 580, pl. 26. fig. 8.

Corbula disparilis Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 247.

Corbula (*Aloidis*) *vieta* Dall, 1898, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 859.

Corbula (*Aloidis*) *vieta* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 395, pl. 39, fig. 13.

The members of this group of *Corbulæ* are difficult to separate satisfactorily as all are quite similiar in their characters. The right valve is broad, high and coarsely sculptured with regular concentric costæ, while the left valve is much smaller, longer than high, with its surface smooth or faintly lined with unequally distributed radial threads.

The *C. vieta* was described by Guppy from the Manzanilla beds of Trinidad and most authors have regarded the *Erycina tensa* described at the same time as its left valve, an indentification which is open to question. Guppy's figure of *tensa*, shows a Veneroid shell strongly sculptured with even radials and fine concentric lines, and quite unlike the left valves of *Corbulæ* of the *Aloidis* section.

? *Corbula vieta* from Costa Rica is identical with Maury's specimens from the Miocene of Santo Domingo. It is a smaller and more circular shell than the *Corbula heterogenea* Guppy which we have from the Canal Zone.

Length 6.25, height 6.50, semi-diameter 3 mm. (right valve)

Gatun Stage: Water Cay.
Hill 1a, 3, Banana River.

Section **CUNEOCORBULA**, Cossman

Corbula oropendula, n. sp. Plate 28, figures 12, 13, 14, 26, 27

Shell small, solid, elongate, both valves of nearly equal convexity but the the right valve somewhat larger and overlapping on the left; beaks nearly central, the anterior end well rounded, the posterior somewhat contracted, slightly rostrated and with a well-marked keel; ventral margin more or less rounded, terminating at is posterior end in a small sinus, just anterior to the keel; the basal margins of both valves are folded in and flattened as seen in *C. contracta* Say but to a less extent and least in the right valve; surface sculpture of rather heavy concentric costæ, most widely spaced on the umbos; the surface may also show fine radial lines of small pustules or punctæ which are best developed on the rostrum; no lunular pit.

Length 6.5, height 4.25, diameter 4 mm (Banana River).
9 6 semidiameter 2 mm (Saury).

We have chosen as the type of this spceies, the smaller and more abundant form as found in the Gatun bed of the Banana River, rather than the larger shells from the more inaccessible Saury. It is related to the *C. contracta* Say, but differs in having the ventral margin more curved, and the posterior extremity more emarginate. Its surface is sculptured with rather strong, concentric costæ which are more widely spaced on the umbos, and submicroscopic radial lines of fine punctæ or small pustules, best seen on the rostral areas.

Gatun Stage: Hills 1a, 3, Banana river (abundant).
Zone G, Saury creek.
Coll. 6, Red Cliff creek.

Corbula Dietziana C. B. Adams Plate 21, figure 8

Corbula Dietziana C. B. Adams, Contr. Conch., vol. 12, p. 235.

Corbula (*Cuneocorbula*) *Dietziana* Dall, 1898, Trans. Wagner Free Inst. Sci., vol, 3, pt. 4, p. 856.

A recent species quite common in the coralline limestones of the Limon Peninsula, from which it has previously been reported by Dall from specimens collected by Hill.

In its earlier stages of growth, this species resembles the *C. æquivalvis* Phil. (*C. cubaniana* d'Orb) in its rectangular from and strong dorsal keel. Later in life, the shells become strongly distorted, the ventral margin is abruptly bent downwards nearly at right angles to the former plane of the shell as is seen to a much less degree in the recent *C. contracta* Say. Its surface is coarsely concentrically grooved, the two valves being sculptured alike.

Gatun Stage: Port Limon.

Corbula hexacyma Brown and Pilsbry Plate 21, figures 12, 13

Corbula hexacyma Brown and Pilsbry, 1912, Proc. Acad. Nat. Sci. Phila., vol. 64, p. 518, pl. 26, fig. 4.

A species of the Gatun beds of the Central Zone. The shell is rather large, solid and with its valves similiary sculptured with a few, deep, wave-like, concentric ribs. Its right valve is slightly more convex than its left. Our specimens measure:

Length 20, height 14, diameter of the left valve 6.00 mm.

Length 20, height 13.50, diameter of the rigth valve 5.75 mm.

Gatun Stage: Gatun, C. Z.

Corbula orosi, n. sp. Plate 21, figures 9, 10

Shell elongate, convex with the low inconspicuous beaks about the middle of the shell, so that the posterior and anterior ends of the shell are about equal in length; the right valve is slightly larger and its basal margin folds over slightly that of the left valve; anterior end rounded, the posterior narrow and more pointed but with the keel only very poorly developed; the surface is finely and evenly concentrically ribbed and both valves are similiarly sculptured; no lunule.

Length 20, height 11.5, diameter of both valves 9.5 mm.

A rather large species with nearly equally convex valves; surface sculptured with fine, regular, concentric ribs. It resembles the *C. sarda* Dall, from the Chipola Miocene but is much larger.

Gatun Stage; Hill No. 3, Banana River.

Section **BOTHROCORBULA,** Gabb

Corbula viminea Guppy Plate 28, figure 25

Corbula viminea Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p. 293, pl. 28, fig. 11.

Bothrocorbula viminea Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15 p. 247.

Corbula (*Bothrocorbula*) *viminea* Dall, 1898, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 850.

Corbula (*Bothrocorbula*) *viminea* Maury, 1917, Bull. Amer. Pal., vol. 5, p. 397, pl. 39, figs. 20, 21.

This is a very characteristic species, distinguished by its large, deep lunule and its surface strongly sculptured with coarse, concentric, wave-like costæ. It is known from the Miocene of Jamaica and Santo Domingo.

The *Corbula hexacyma* Brown and Pilsbry, still known only from the Gatun of the Canal Zone is similiar in form and sculpture but lacks the deep lunular pit.

Length 15, height 10, semi-diameter 4.85 mm (right valve).

Gatun Stage: Middle creek.

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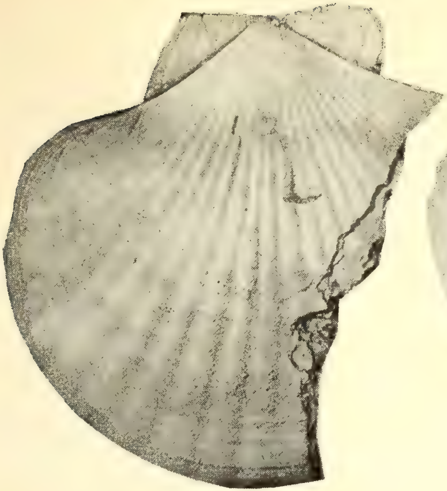
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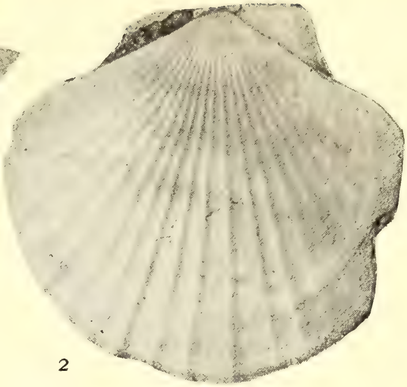
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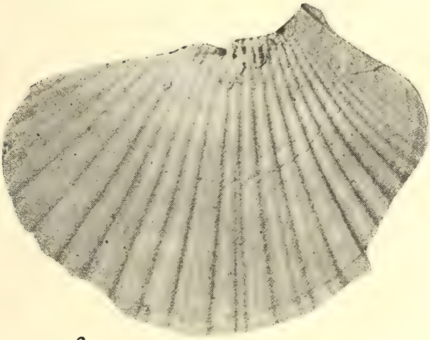
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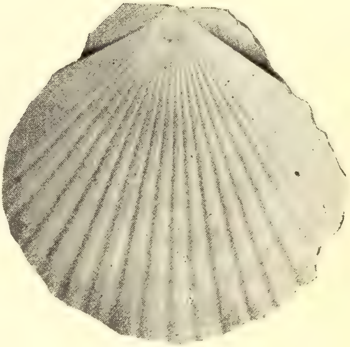
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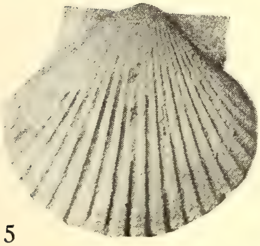
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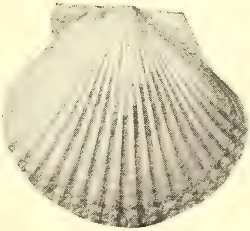
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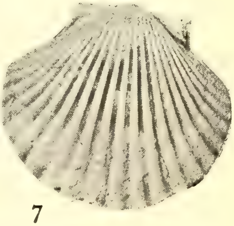
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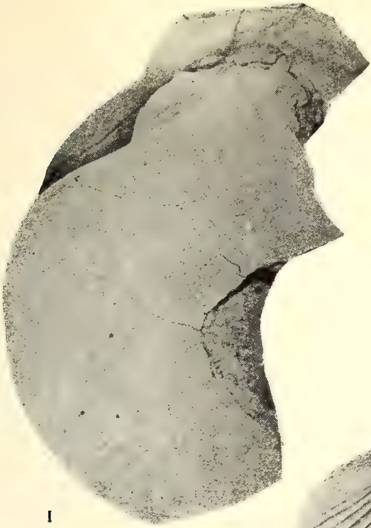

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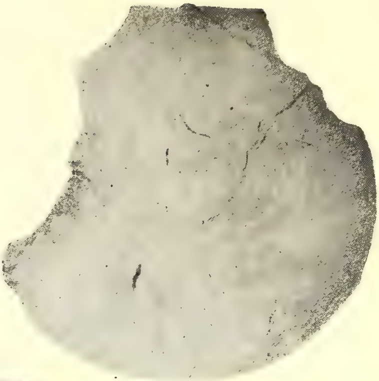

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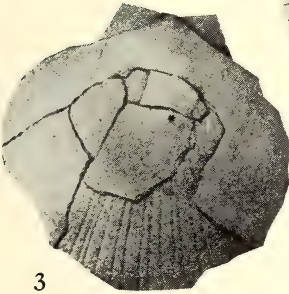

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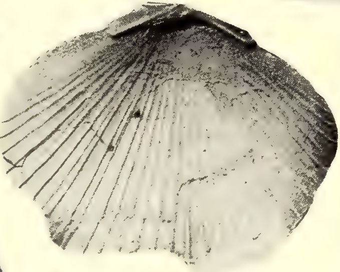

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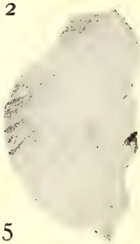

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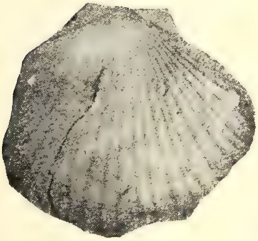

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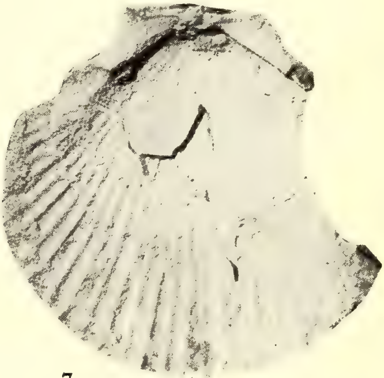

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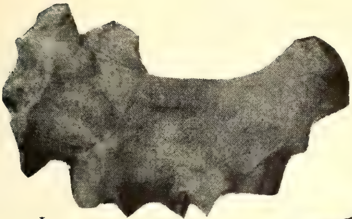
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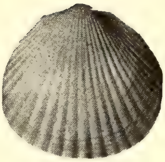
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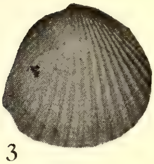
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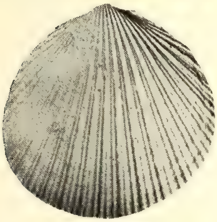
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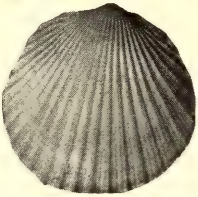
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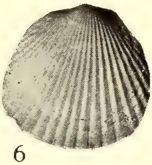
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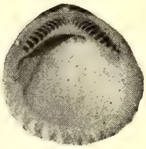
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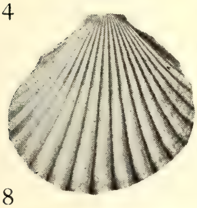
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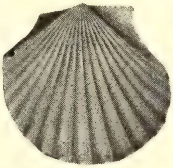
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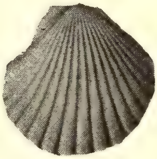
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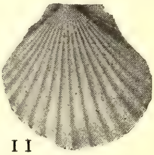
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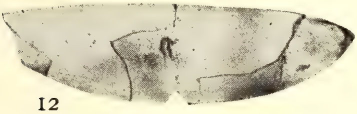
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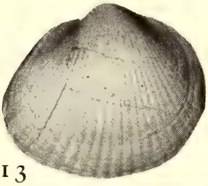
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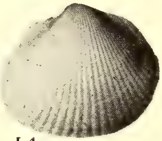
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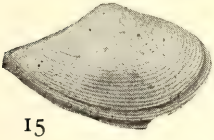
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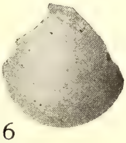
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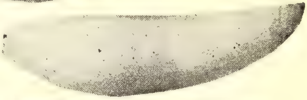
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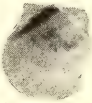
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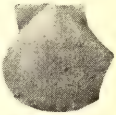
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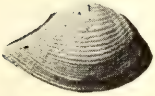
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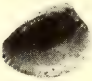
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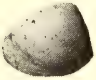
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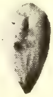
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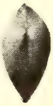
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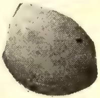
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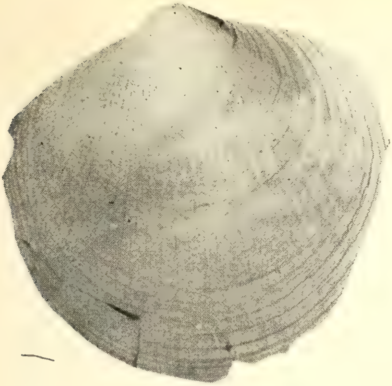

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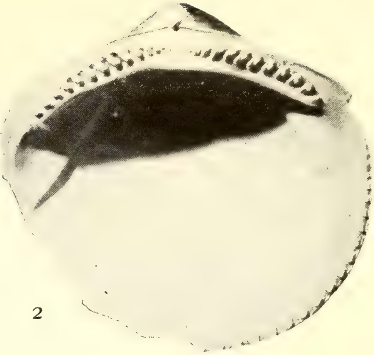

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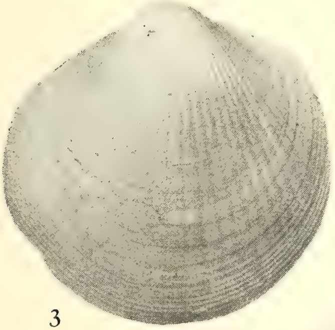

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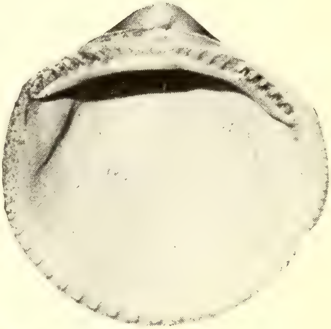

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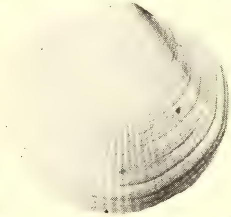

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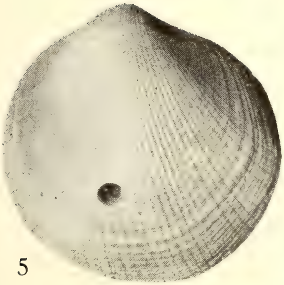

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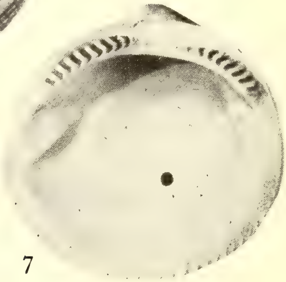

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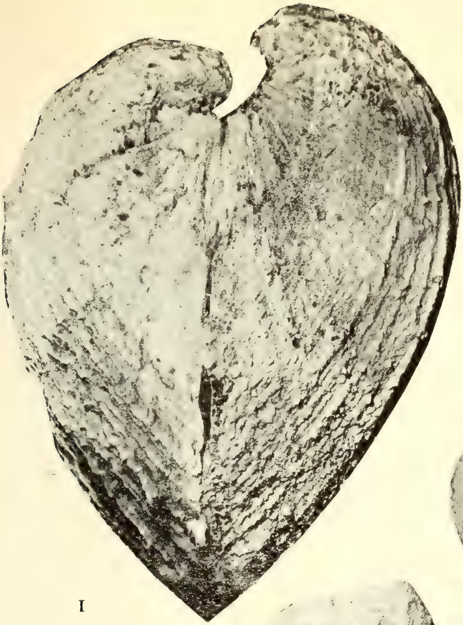

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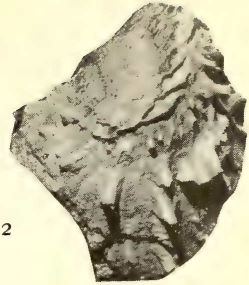

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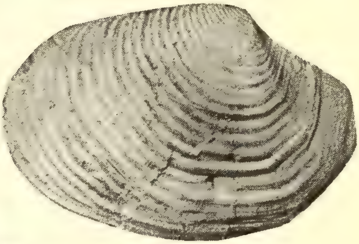

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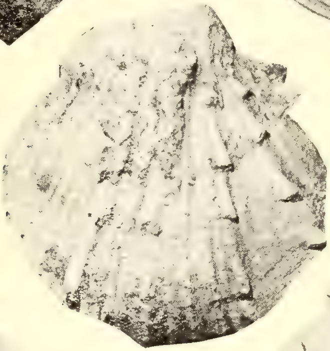

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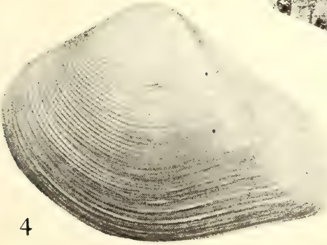

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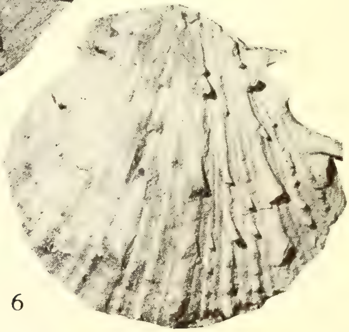

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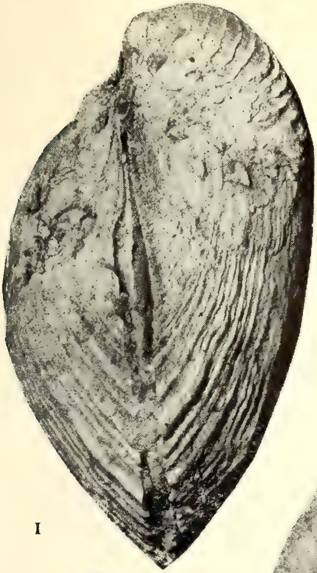

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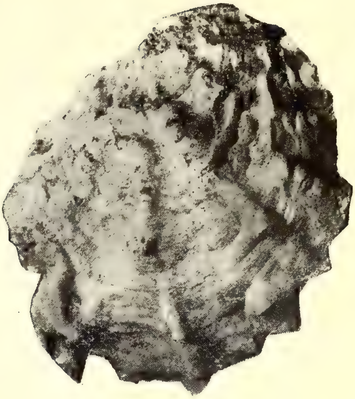

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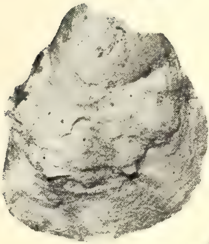

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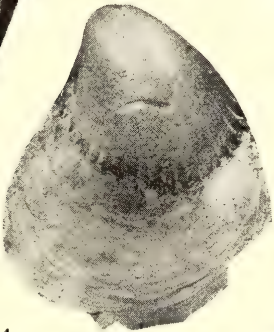

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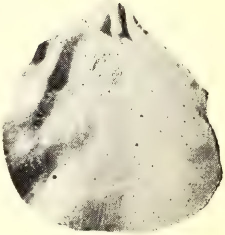

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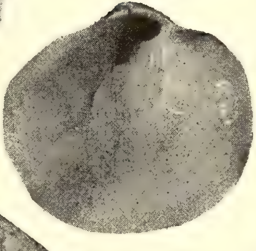

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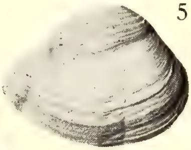

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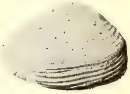

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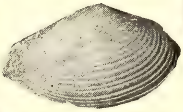

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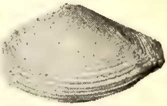

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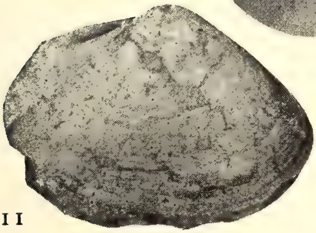

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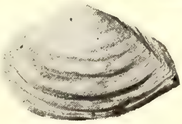

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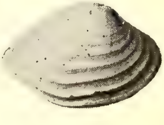

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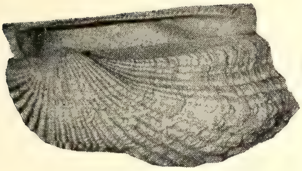

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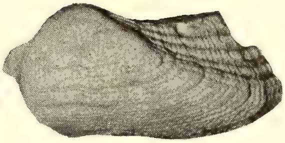

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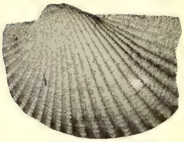

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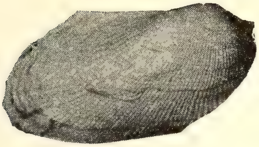

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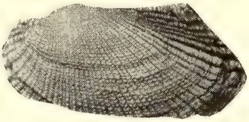

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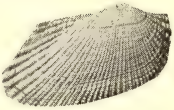

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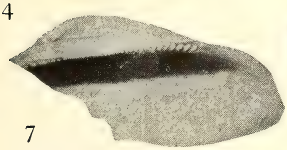

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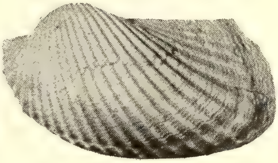

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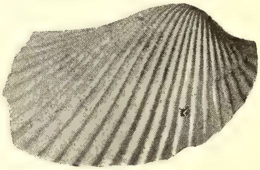

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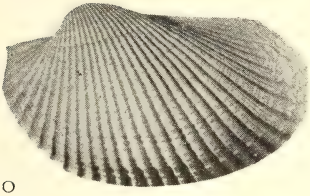

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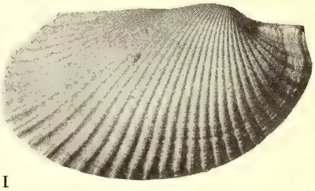

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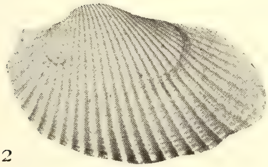

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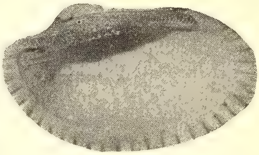

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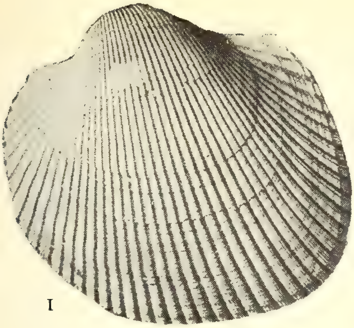
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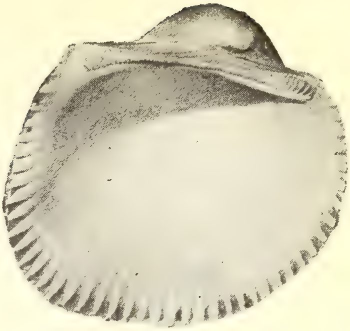
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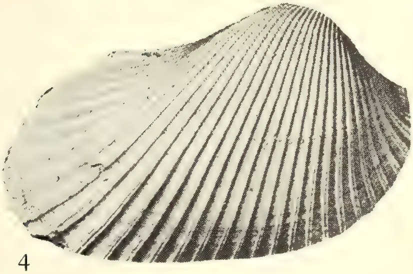
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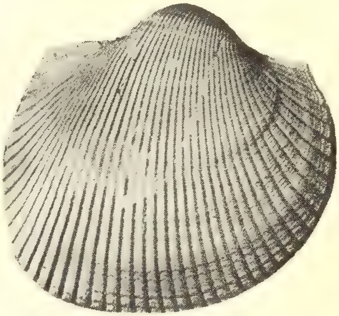
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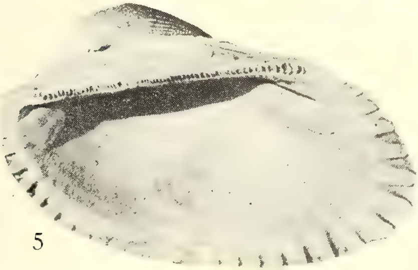
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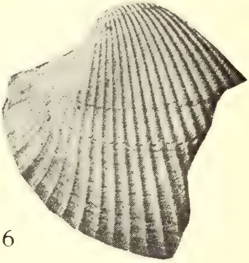
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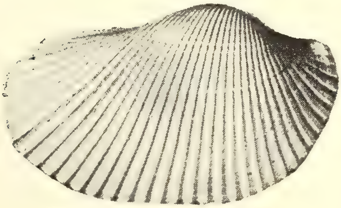
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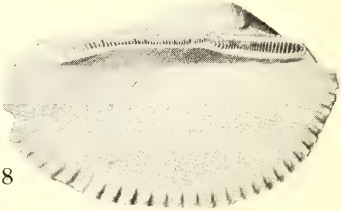
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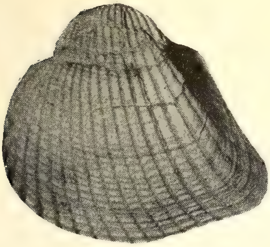
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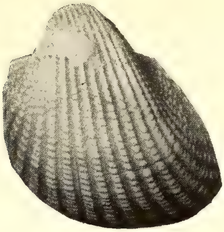
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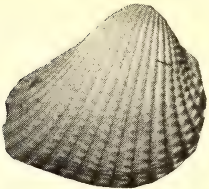
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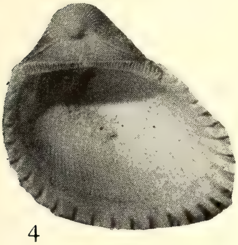
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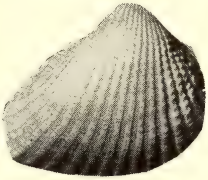
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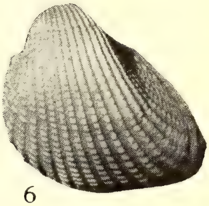
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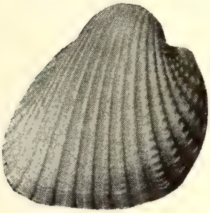
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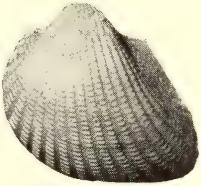
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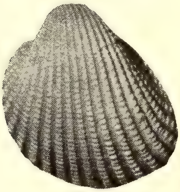
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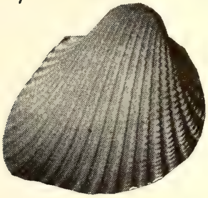
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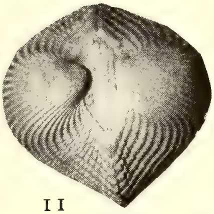
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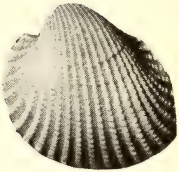
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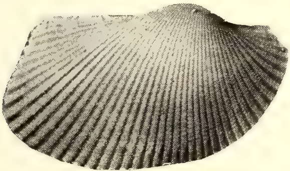
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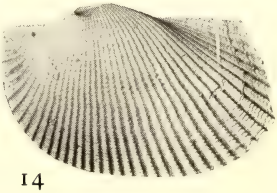
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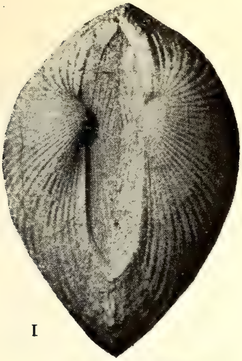

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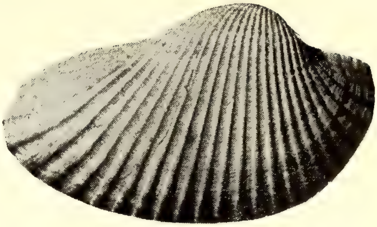

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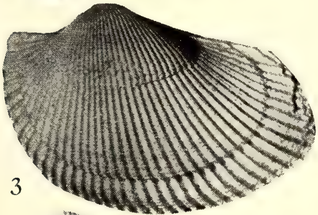

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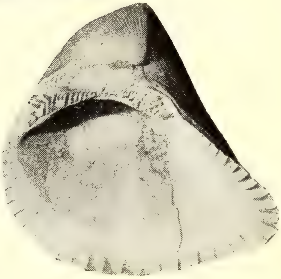

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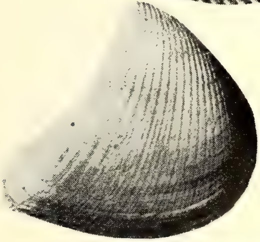

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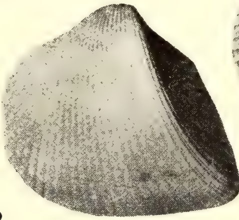

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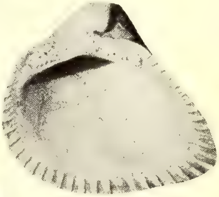

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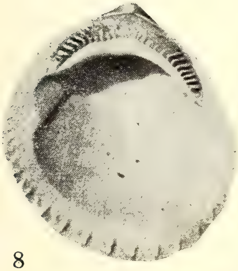

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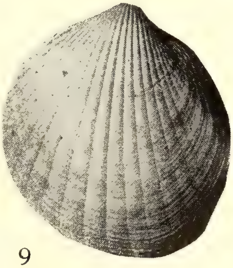

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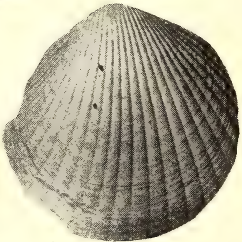

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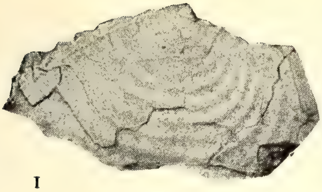
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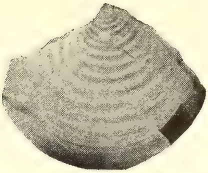
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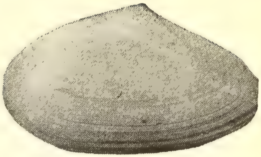
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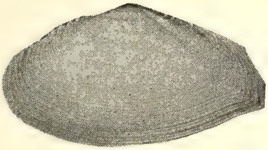
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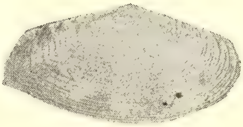
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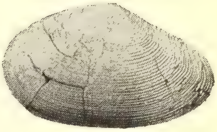
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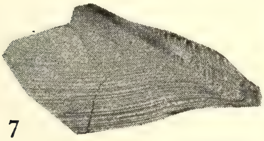
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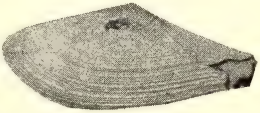
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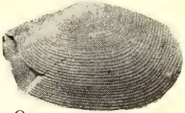
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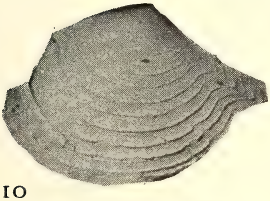
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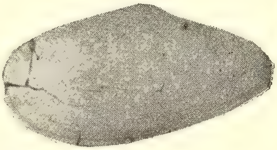
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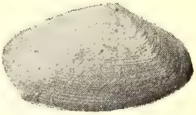
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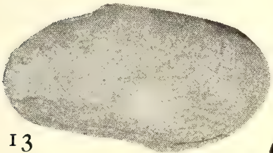
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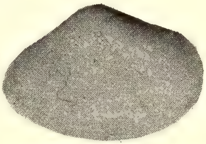
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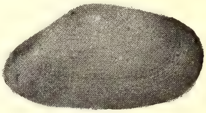
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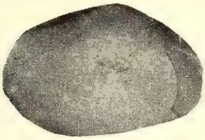
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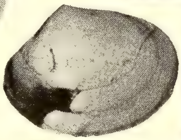
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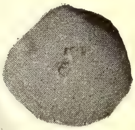
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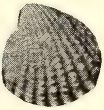
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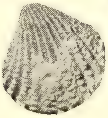
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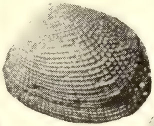
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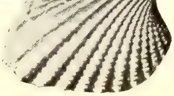
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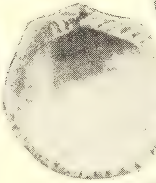
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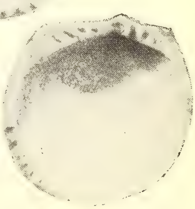
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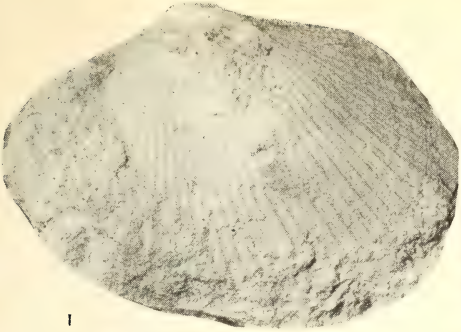
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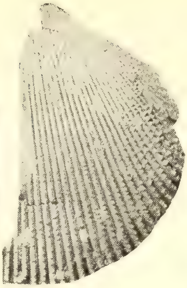
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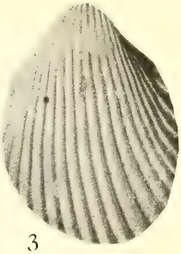
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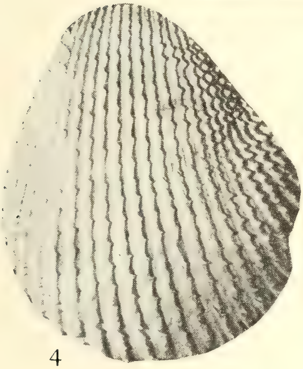
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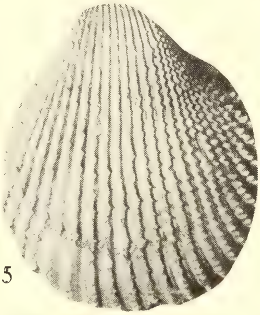
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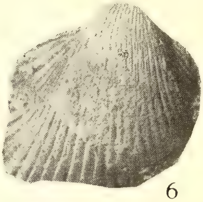
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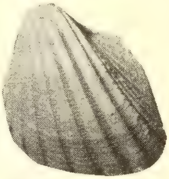
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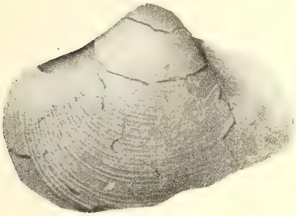
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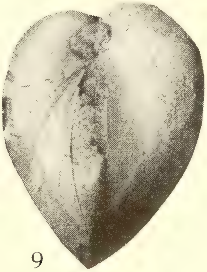
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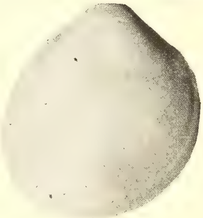
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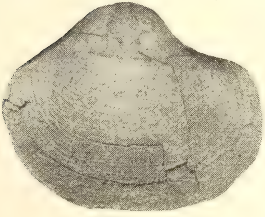
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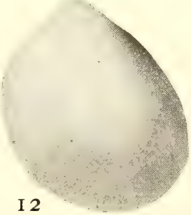
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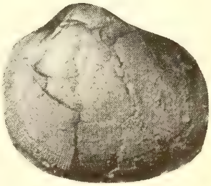
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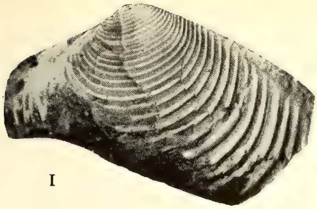
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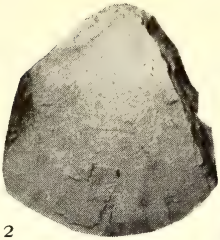
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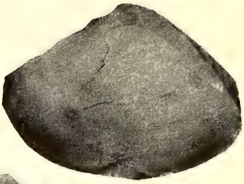
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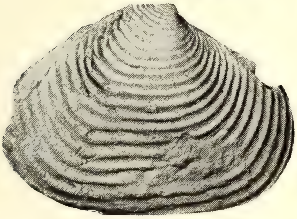
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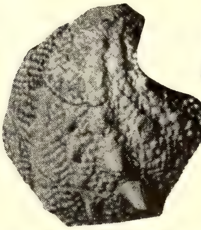
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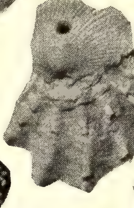
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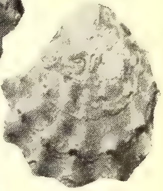
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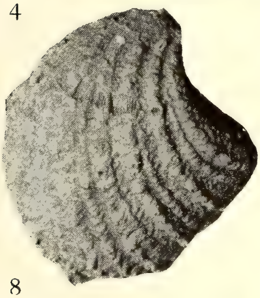
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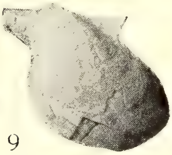
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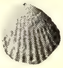
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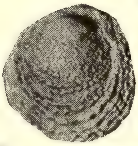
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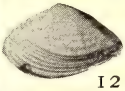
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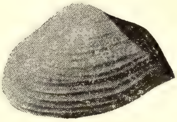
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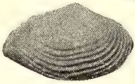
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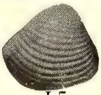
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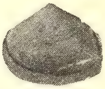
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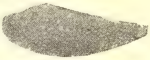
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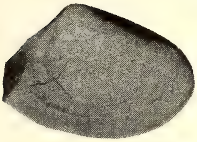
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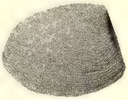
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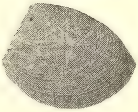
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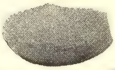
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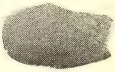
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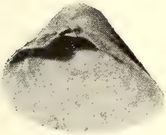
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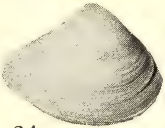
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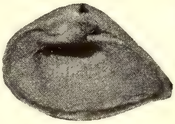
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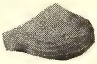
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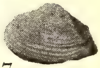
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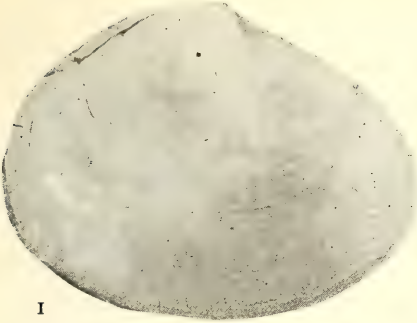
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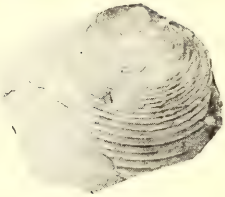
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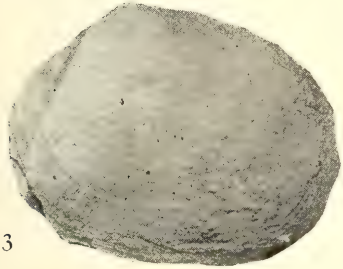
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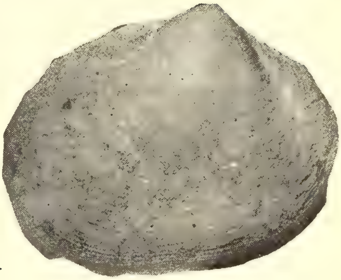
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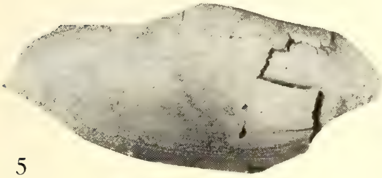
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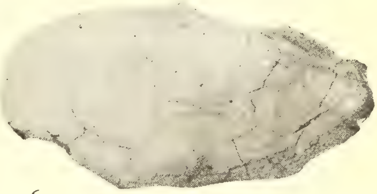
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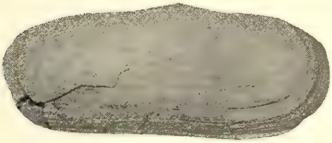
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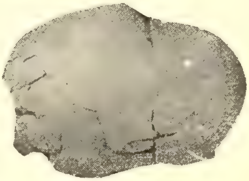
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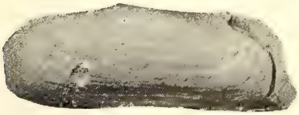
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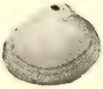
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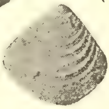
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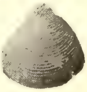
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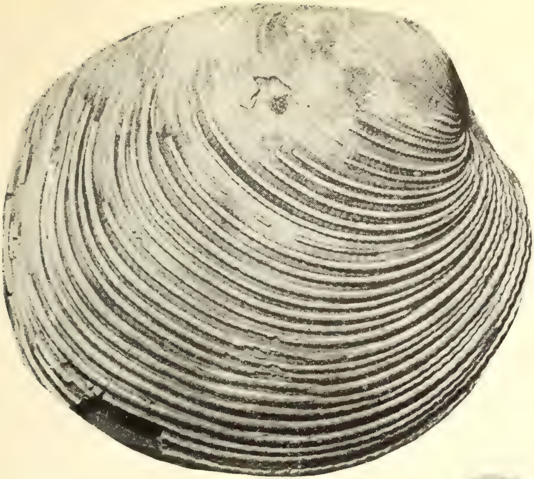

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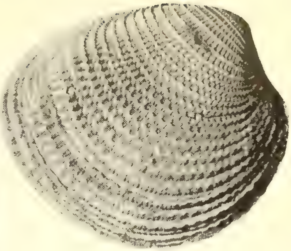

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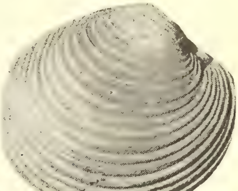

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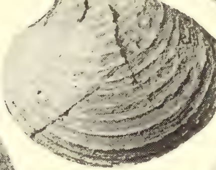

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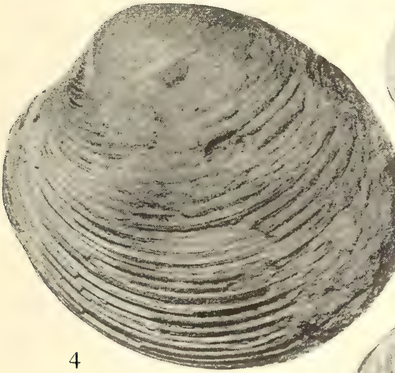

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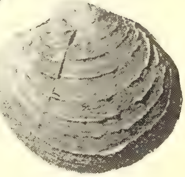

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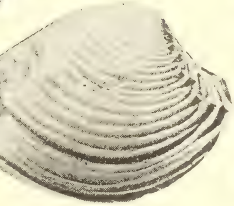

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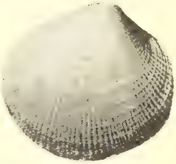

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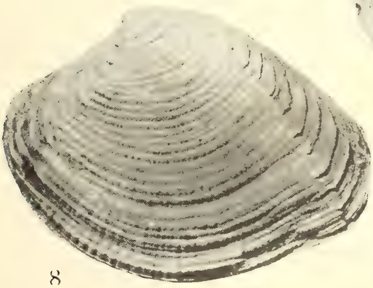

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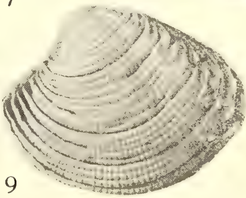

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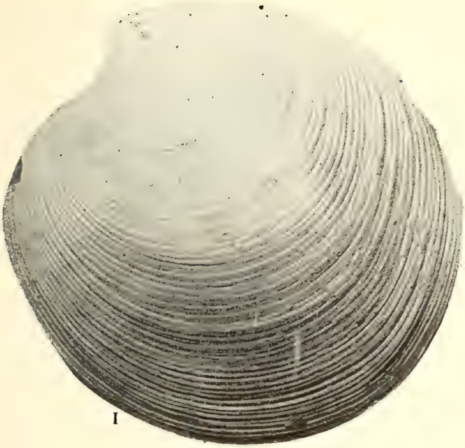
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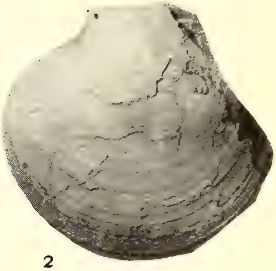
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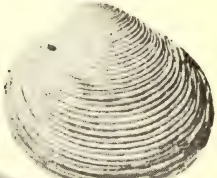
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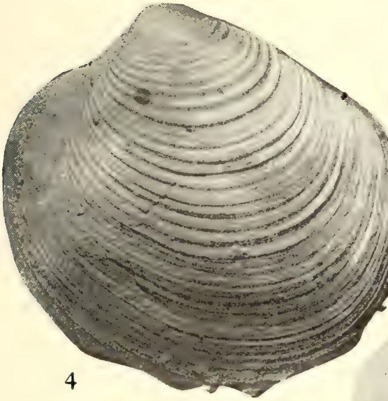
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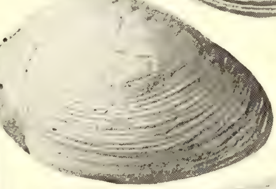
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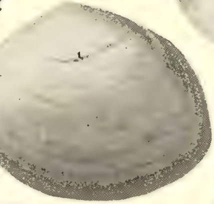
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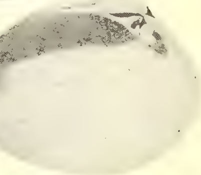
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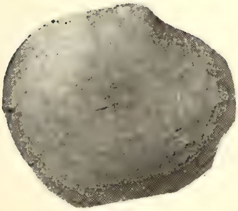
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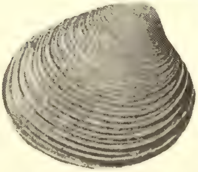
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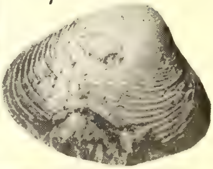
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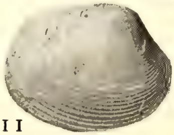
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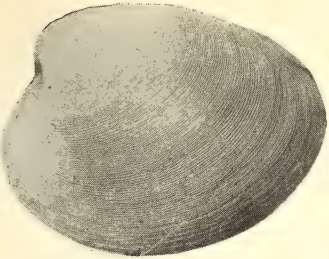
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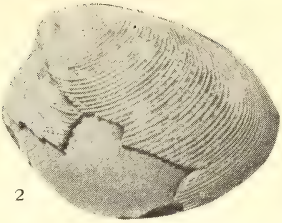
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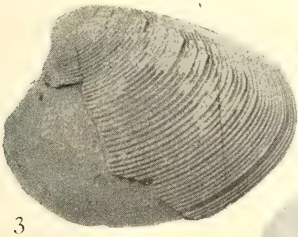
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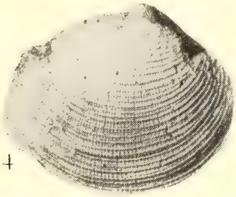
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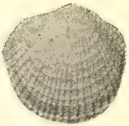
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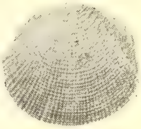
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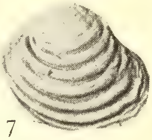
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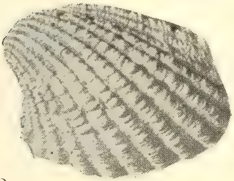
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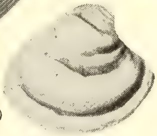
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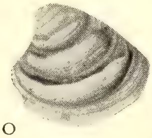
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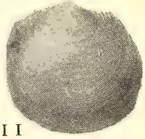
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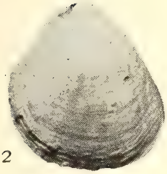
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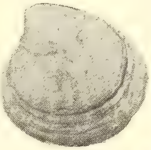
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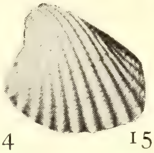
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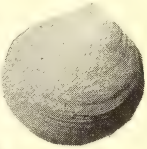
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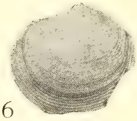
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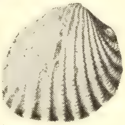
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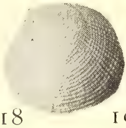
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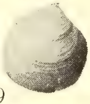
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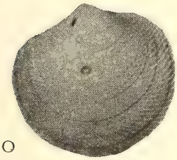
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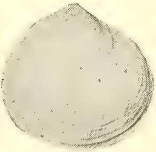
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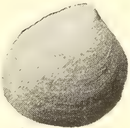
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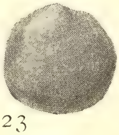
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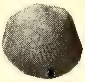
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ADDENDA ET CORRIGENDA

NOTE.—All page references are to the Volume and not the separate Bulletins.

Page	
47	For RNIGICULA read RINGICULA.
58	For *Siphonaria lineolata* d'Orb. (name preoccupied) substitute *S. naufraga* Stearns.
75	For *Oliva circinata* Marrat substitute *O. sayana* Ravenal (Cat. p. 19, 1834) and place *circinata* in synonymy.
77	For *Marginella apicinca* read *apicina*.
81	For *Scaphella junonia* substitute *Maculopeplum junonium*, this species being the type of *Maculopeplum* Dall, 1906.
101	For *Epitomium* read *Epitonium*.
104	*Janthina communis* is regarded by Johnson (Nautilus, 1922) as identical with *J. janthina*. Bartsch, however, considered *communis* and *fragilis* (equals *ianthina*) to be distinct (Bull U. S. N. M. 1915). The latter opinion is followed here.
164	For *Petrotrochus* read *Perotrochus*.
188	For *Chione Rowelli* read *ChioneRowleei*.
206a	After *Acteon costaricensis*, n. sp. insert Pl. 15, fig. 15.
275	For *Fuses miocosmius* read *Fusus miocosmius*.
306	After *Bursa crassa*, for Pl. 15, fig. 15 read Pl. 15 fig. 19.
318	For H. B. Lea read H. C. Lea.
405	For *Gafrarium limonensis* read *Gafrarium limonense*.

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